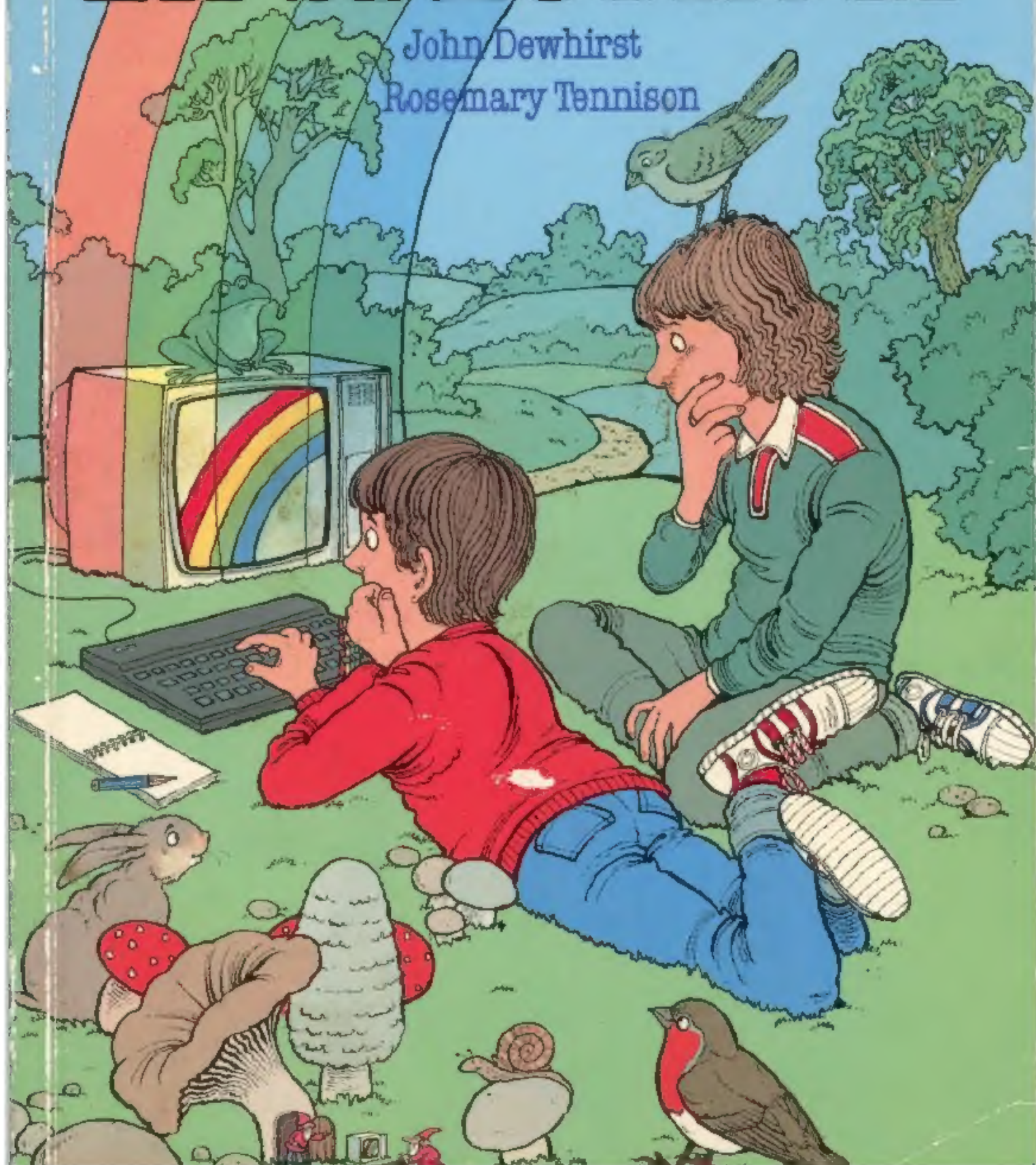


A child's guide to the
ZX SPECTRUM

John Dewhirst
Rosemary Tennison



A CHILD'S GUIDE TO THE ZX SPECTRUM

**John Dewhirst
Rosemary Tennison**

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INTRODUCTION

Each section of the book is written by a different person. Each person is an expert at his or her job and gives very useful advice. Read their advice very carefully. The advice is given at the start of each section of the book. If you follow the advice it will make the work you do much easier.

SECTIONS

1. The keyboard

by Pru Comet – typist.

Pru Comet shows you the ways in which the various types of keys work and the position of the keys on the keyboard.



2. Getting started

by P. C. Truemo – investigator.

Constable Truemo shows you how to get started on the computer, how to make it print numbers and words, calculate answers and finally store items in its memory.



3. Writing programs

by Prof. O. Crumpet – designer.

Professor O. Crumpet shows you how to copy, adapt, then finally design your own programs.



4. Special features

by Mort Puce – artist.

Mort Puce shows you how to draw coloured pictures on the screen and to make the computer play music.



5. Finding out

by Miss O. C. Termup – librarian.

Miss O. C. Termup shows you how to use the reference sections.



Dear Reader,

Hello there. We are the people who have written this book and you will find out more about us as you read through it. When you meet us we shall introduce ourselves.

The book has been written for people who know nothing about computers, but who want to find out for themselves. It has been written to show you not just what the computer can do, but more importantly, what *you* can make the computer do for you.

We have put together all our good ideas so that it is easy for you to find out just how the ZX Spectrum works. The book is written in five sections and we have each written a section. The first four sections are to be read and worked through in order, but the last section is for reference and this can be used at any time for checking.

Happy computing!

Prudence Comet

Prudence Comet

Bobby Truemo

Bobby Truemo

Oliver Crumpet

Oliver Crumpet

Mort Puce

Mortimer Puce

live Constance Termup

Olive Constance Termup

In each section of the book you will come across different types of diagrams. The things for you to try, that is various exercises and experiments, will all be given in a 'You try' box. The 'You try' box looks like this.



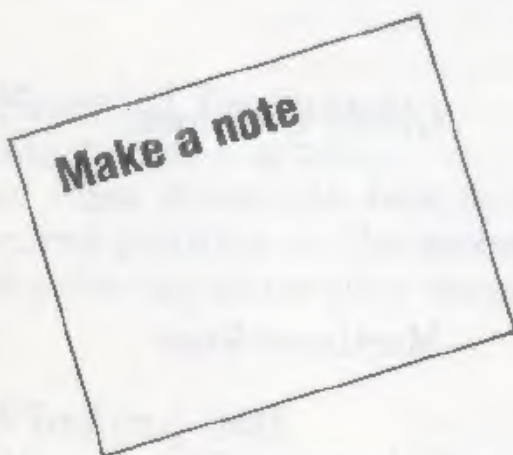
You try



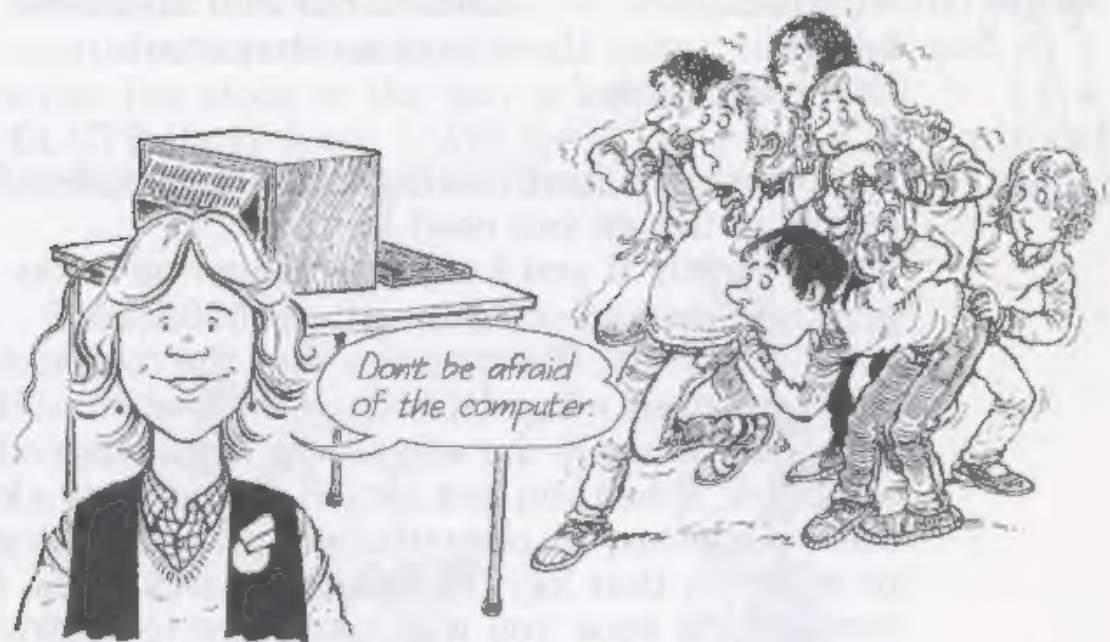
The things which are displayed on the screen will all be shown in a 'Display' box. The 'Display' box looks like this.



The things which you need to make a note about and remember will all be given in a 'Make a note' box. The 'Make a note' box looks like this.



THE KEYBOARD



Pru Comet

My advice

Don't be afraid of the computer. Think of it as a typewriter with a difference. Try things out. In this way you will learn quickly just what it can and cannot do. When you try things out, the computer will send messages back to you. This is the way the computer talks to you. It can make noises, change colours on the screen and do lots of other things, so you'll need a bit of time to learn about everything the computer can do. Your first job is to learn about the keyboard, find out where all the keys are and what they all do. A good idea is to make your own notes in a book of all the things you find out about the computer.

As you read through the keyboard section of the book, try things out as you go along. Don't be put off by any messages the computer sends to you. It does not realise that you are a beginner and just trying out a few things for yourself. As you work through the rest of the book you will learn the language that the computer understands, but like learning any language you can only learn a bit at a time.

Pru Comet



There are 40 keys on the ZX Spectrum and their uses can be divided into the following sets.

Controls
Numbers
Letters
Edit commands

Special symbols
Commands and functions
Graphics characters

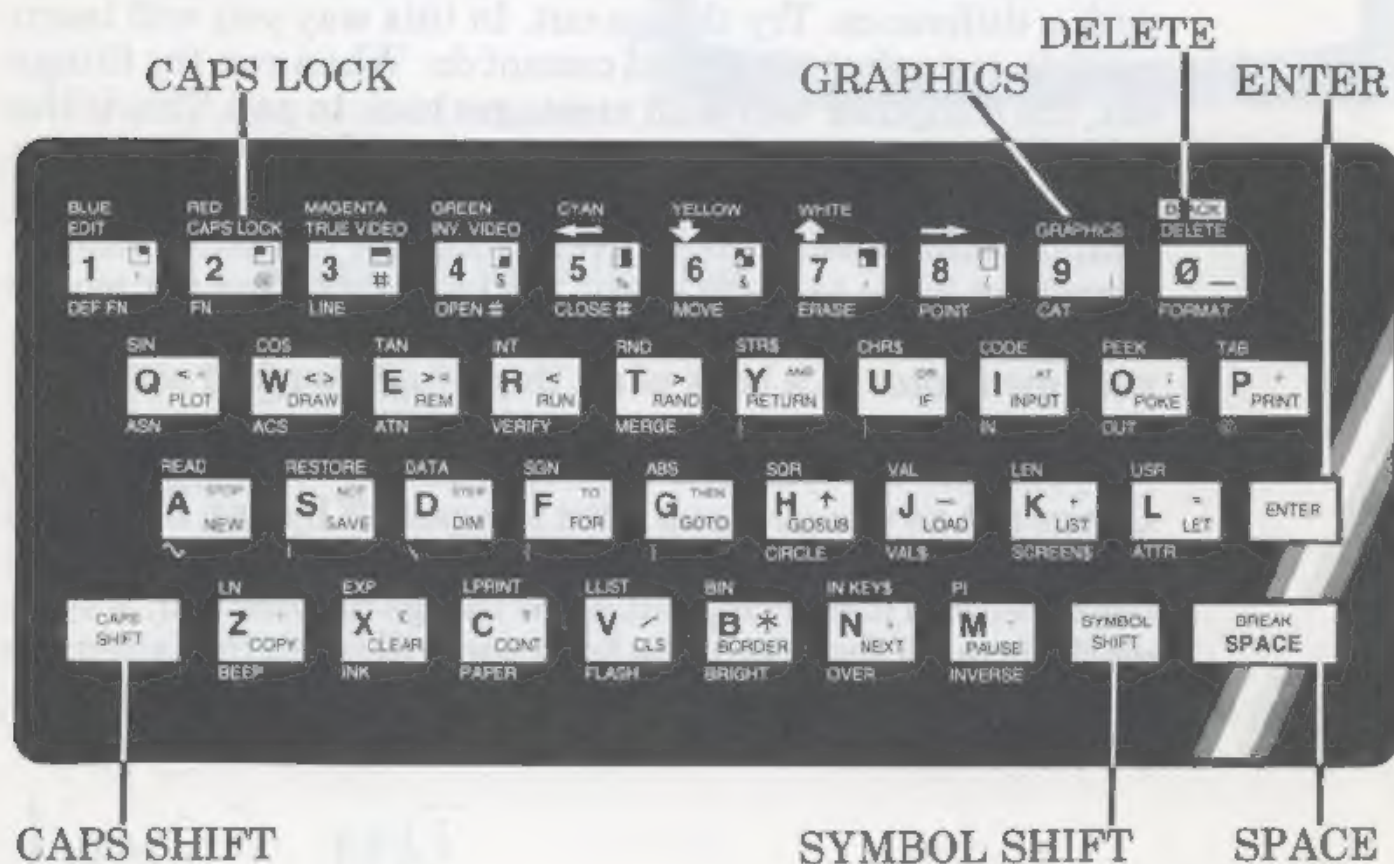
But before you start looking at the keys in detail there are a couple of things you need to know.

Firstly if you keep your finger on a key it will keep printing; instead of 5 you will get 555555555 . . . and so on.

Secondly, the message that the computer receives when you press a key depends on the mode that the computer is in. The mode is the way a key is understood by the computer. When you first switch on and press a key on which there is a letter, the computer will print out the word written in white on that key. This is command mode. As you read through the book you will learn how to control the mode. Each mode is shown by a different flashing letter, called the cursor, at the bottom of the screen. In command mode the letter is K.

Controls

There are seven control commands.





ENTER makes the computer read the line you have just typed.

SPACE moves the cursor one space to the right and so inserts a space.

CAPS SHIFT makes the computer understand a letter key as a capital rather than as a small letter. It is also used to change the mode or the way a key is understood.

DELETE (hold down **CAPS SHIFT** and press **[0]**) rubs out the character to the left of the cursor.



CAPS SHIFT

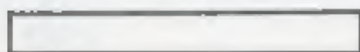


CAPS LOCK

SYMBOL SHIFT makes the computer understand a key as the word or symbol in red on the key or below it, depending on the mode the computer is in.

CAPS LOCK (hold down **CAPS SHIFT** and press **[2]**). When this has been pressed it is like having **CAPS SHIFT** held down all the time.

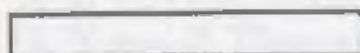
GRAPHICS (hold down **CAPS SHIFT** and press **[9]**). When this has been pressed, the number keys 1 to 8 produce graphics characters. You will learn more about these later in this section.



This is what will appear on the screen:

You try

Press **SPACE** carefully three times.





You try

Hold down the number key 1 until the cursor goes onto the next line.



You try

Press **DELETE** once (hold down **CAPS SHIFT** and press **0**).

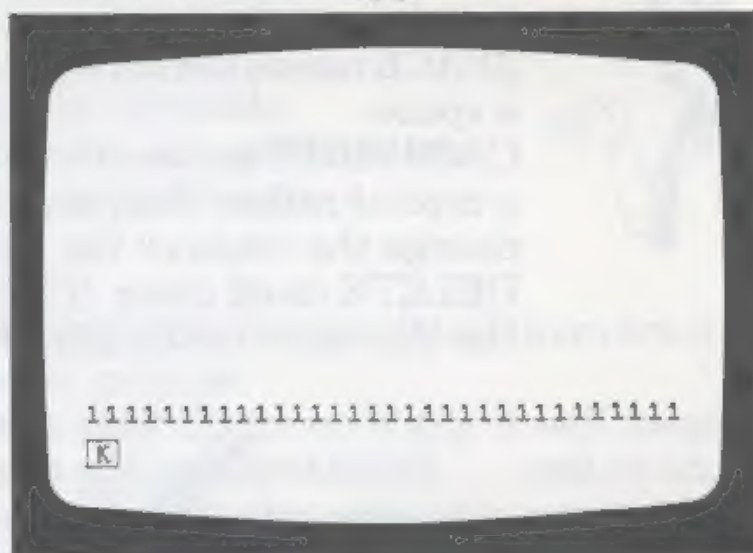
You try

Press **DELETE** until the cursor is back to its first position.

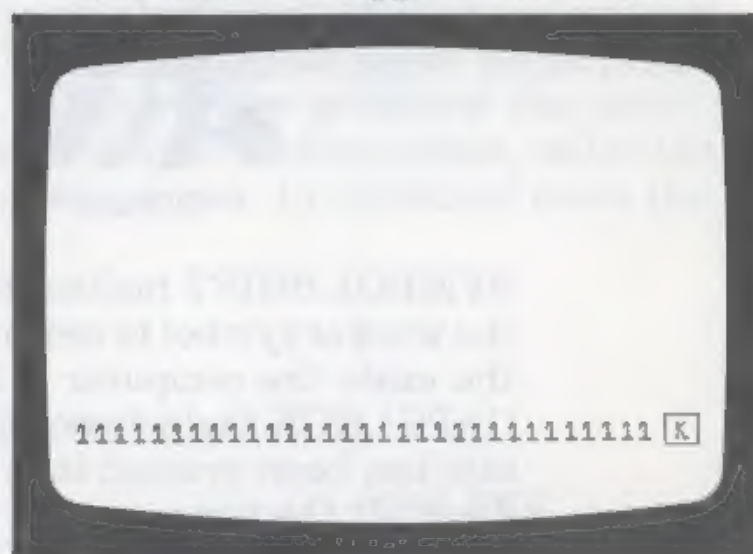
Make a note

Each time **DELETE** is pressed the cursor moves one place to the left and rubs out any letter or number which is there.

This is what will appear on the screen:



This is what will appear on the screen:



This is what will appear on the screen:





Numbers

These are the ten keys which print the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9 and Ø. On the keyboard they are set out in a line:

1 2 3 4 5 6 7 8 9 Ø.

(The Ø key is used for zero so that it is not confused with the letter O.)

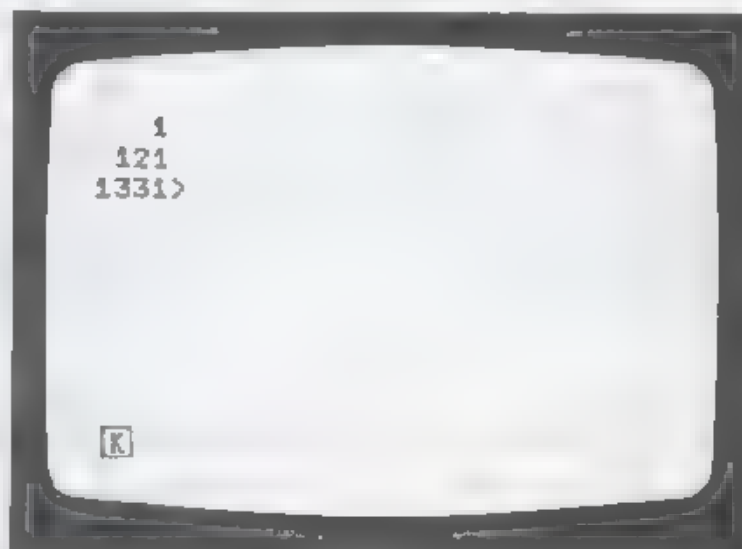
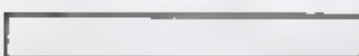


This is what will appear on the screen:

You try

Type out the following. Press **SPACE** and then press **ENTER** at the end of each line.

1
121
1331



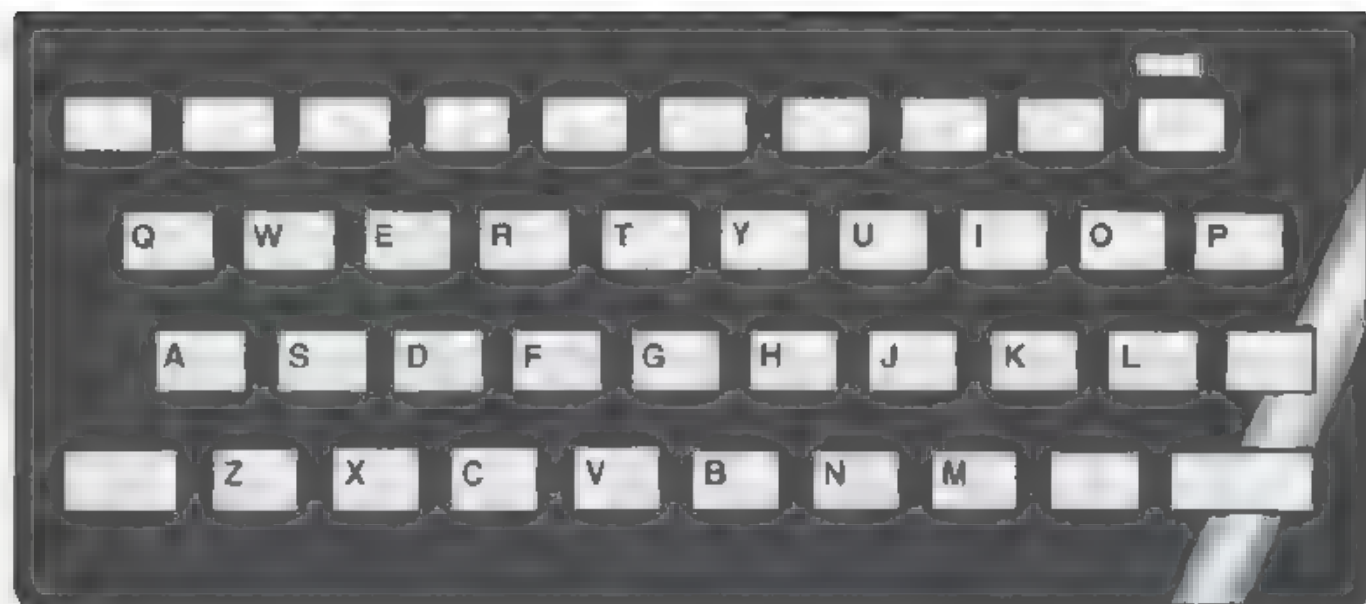
Letters

These are the 26 keys which print the letters of the alphabet A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y and Z. They are also used to print the small letters a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y and z. On the keyboard they are set out as:

Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M

which is exactly the same as you would find them on a typewriter.





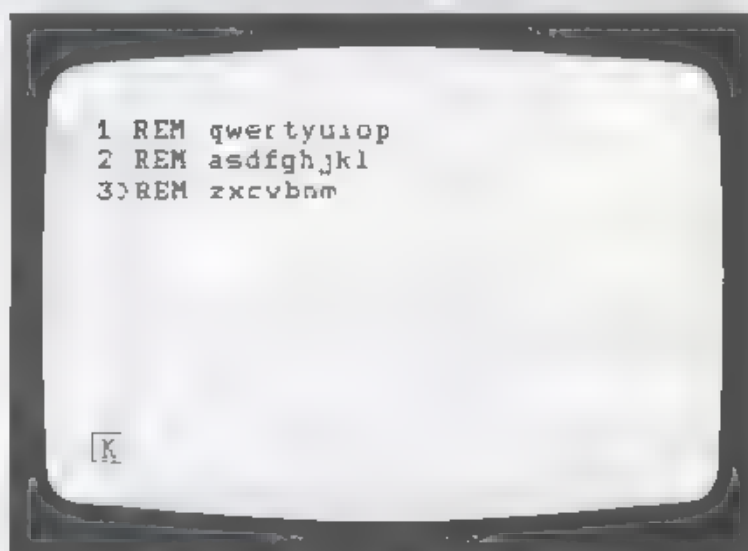
The word REM on key **E** makes the computer display the letters typed and also makes the computer ignore anything typed after it. This makes it useful for practising typing. The computer will put in spaces on either side of REM on the screen so there is no need for you to do it.

You try

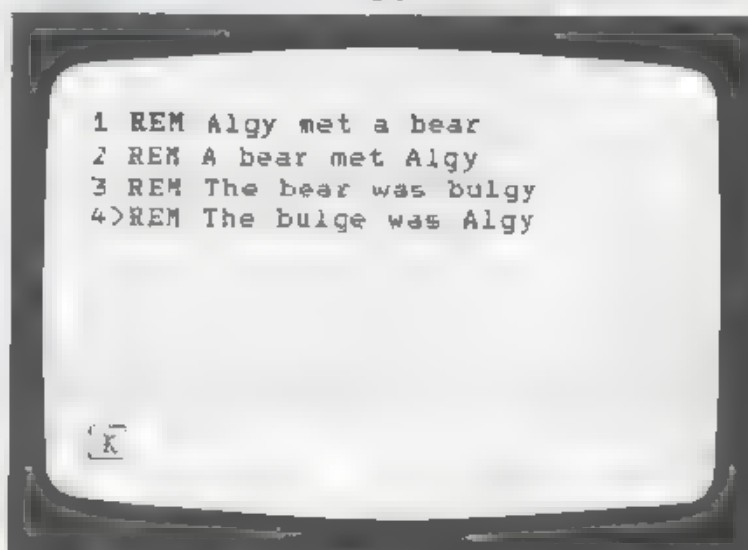
Type out the following. Press **ENTER** at the end of each line. Remember that **REM** is to be found on the key **E**.

- 1 **REM** qwertyuiop
- 2 **REM** asdfghjkl
- 3 **REM** zxcvbnm

This is what will appear on the screen



This is what will appear on the screen



You try

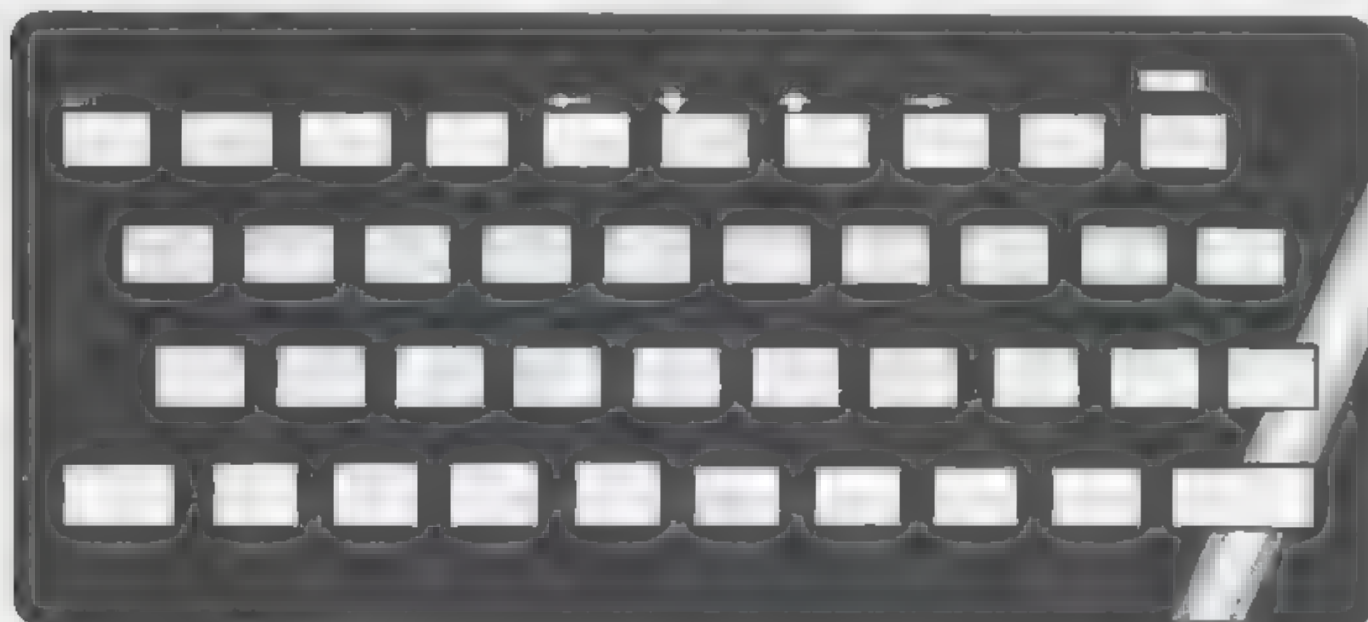
Type out the following. Press **ENTER** at the end of each line. Hold down **[CAPS SHIFT]** when you want a key to print a capital letter

- 1 **REM** Algy met a bear
- 2 **REM** A bear met Algy
- 3 **REM** The bear was bulgy
- 4 **REM** The bulge was Algy

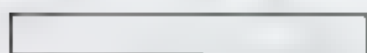
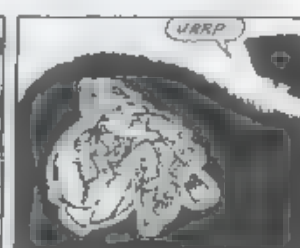
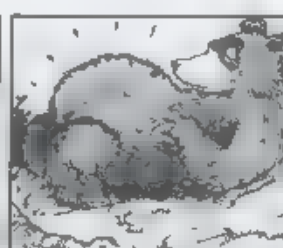


Edit commands

The five edit commands are on the number keys 1, 5, 6, 7 and 8. Four of the keys have arrow signs which point up, down, right and left and the other edit command is EDIT. To operate the edit commands hold down [CAPS SHIFT] and press the number key with the command you want above it.



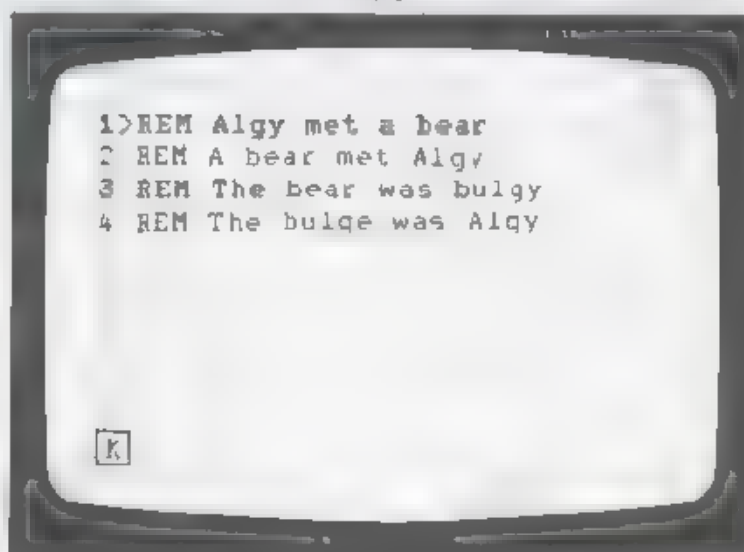
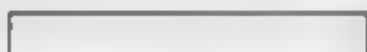
The up and down arrows enable you to choose a line you wish to change.



This is what will appear on the screen

You try

Do the previous 'You try' so that the poem about Algy is on the screen. Press the up arrow key three times (hold down [CAPS SHIFT] and press [7]).



The pointer has moved to line 1 which is the line we wish to change.



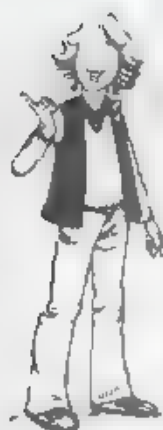
You try

Press **EDIT** (hold down **CAPS SHIFT** and press **1**).



You try

Press the right arrow key 16 times (hold down **CAPS SHIFT** and press **8**).



You try

Press **DELETE** four times (hold down **CAPS SHIFT** and press **0**).

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy
```

```
1F REM Algy met a bear
```

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy
```

```
1 REM Algy met a bear L
```

This is what will appear on the screen:

```
1>REM Algy met a bear
2 REM A bear met Algy
3 REM The bear was bulgy
4 REM The bulge was Algy
```

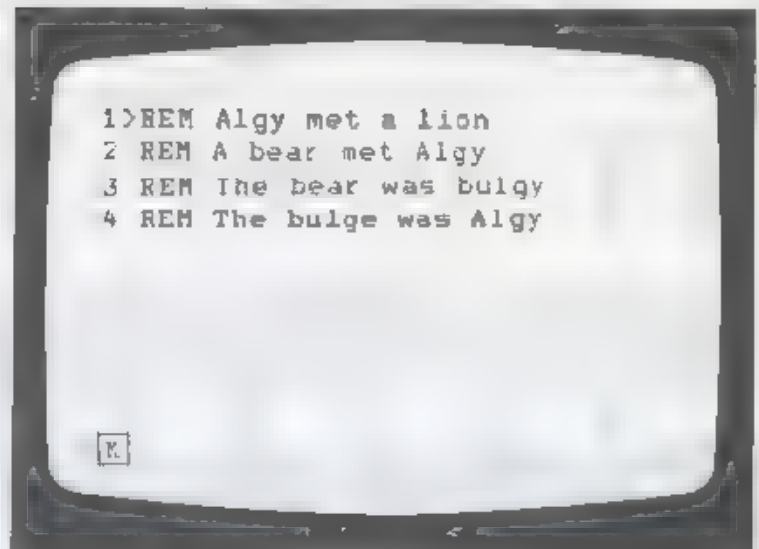
```
1 REM Algy met a L
```


This is what will appear on the screen:

You try

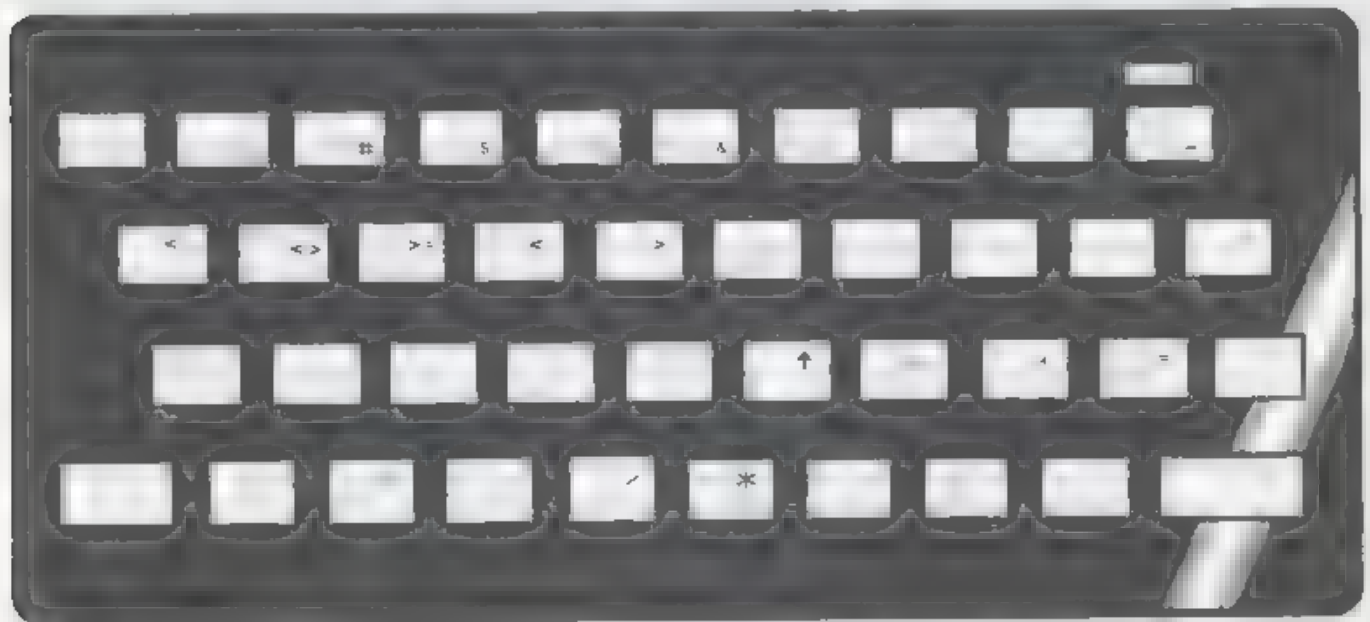
Type the word 'lion'
and then press **ENTER**.

Use the edit keys to change bear
to lion in lines 2 and 3. Change
Algy to Maggie.



Special symbols

There are 36 special symbols which are printed in red on or
below the keys. To type a red symbol on a key hold down
SYMBOL SHIFT (also in red) and then press the key.



You try

Type out the following. Press
ENTER at the end of each line.

- 1 **REM** punctuation ! " ' ; : , . ?
- 2 **REM** arithmetic + - * / % -
- 3 **REM** inequalities < - < > > - < >
- 4 **REM** other \$ £ & @

You try

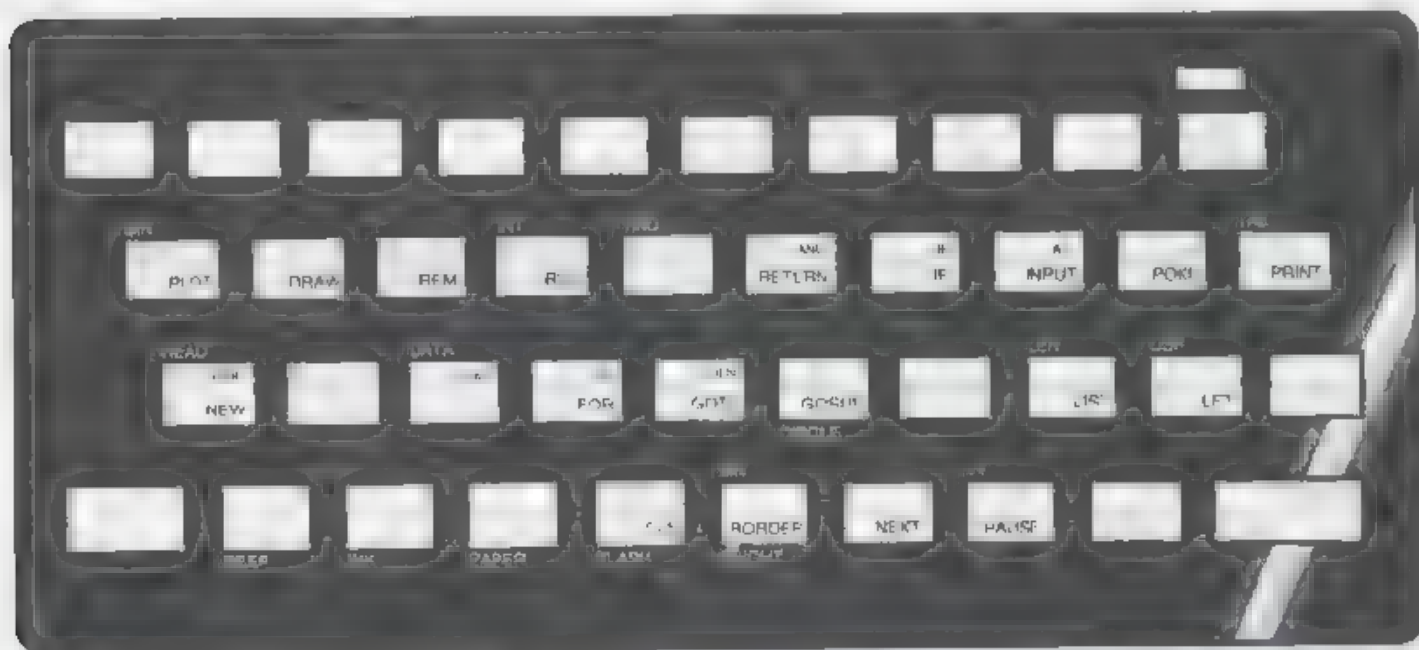
Type out the following. Press
ENTER at the end of each line.

- | | |
|-----------------|----------------|
| 1 REM ! | 6 REM & |
| 2 REM @ | 7 REM ' |
| 3 REM # | 8 REM (|
| 4 REM \$ | 9 REM) |
| 5 REM % | |



Commands and functions

These are all the words written on, above and below the keys. You will learn about a few of them now and about more of them as you read through the book. To help you, the commands and functions explained in this book are shown below.



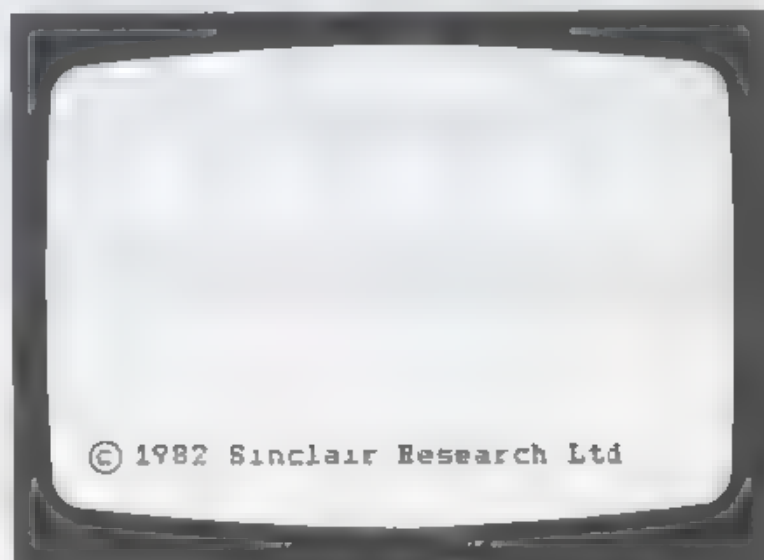
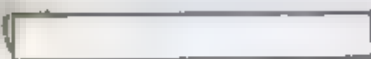
In its normal mode (when the cursor says [K]) the computer reads the word printed in white on the key pressed.



This is what will appear on the screen.

You try

Press [NEW]
(on key A) then
press [ENTER].



Make a note

NEW is on key A and
resets the computer
as if it has just been
switched on.

You try

Press **BORDER** (on key B), then press **1** followed by **ENTER**. Try pressing **BORDER** followed by other numbers.

Make a note

BORDER (on key B) followed by a number gives the colour round the edge of the screen.



To obtain the commands and functions given above and below the keys you need to change mode. To do this hold down **[CAPS SHIFT]** and press **[SYMBOL SHIFT]**. The cursor will change to **[E]** to show that the computer is in extended mode. The computer will now read the words given above the keys.

You try

Hold down **[CAPS SHIFT]** and press **[SYMBOL SHIFT]** to go into extended mode. Press **1** carefully four times. Now put the computer into extended mode again and this time press **2** four times. Try putting the computer into extended mode (with the cursor showing **[E]**) and pressing the number keys 3, 4, 5, 6, 7 and 0.



Make a note

To read the words above the keys go into extended mode by holding down **[CAPS SHIFT]** and pressing **[SYMBOL SHIFT]**. The computer goes back to its normal mode (with the cursor

showing **[K]**) after one key press. To read the words below the keys put the computer into extended mode then hold down **[SYMBOL SHIFT]** and press the key.

To clear the screen after the last 'You try' press **[EDIT]** (hold down **[CAPS SHIFT]** and press **1**).

You try

Hold down [CAPS SHIFT] and press [SYMBOL SHIFT] to put the computer in extended mode, then hold down [SYMBOL SHIFT] and press [X] to give the word 'INK'. Now type 5 and press [ENTER].

Type out the following.

1 [REM] INK is writing colour
Put the computer into extended mode. Hold down [SYMBOL SHIFT] and press [C] to give the word 'PAPER'.

Now type 6 and press [ENTER]. Type out the following.

2 [REM] PAPER is screen colour

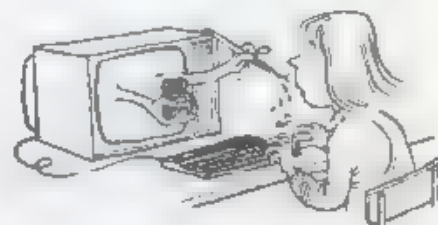
Make a note

To read the word in red below a key go into extended mode by holding down [CAPS SHIFT] and pressing [SYMBOL SHIFT].

Then hold down [SYMBOL SHIFT] and press the key. The computer goes back to its normal mode after one key press.

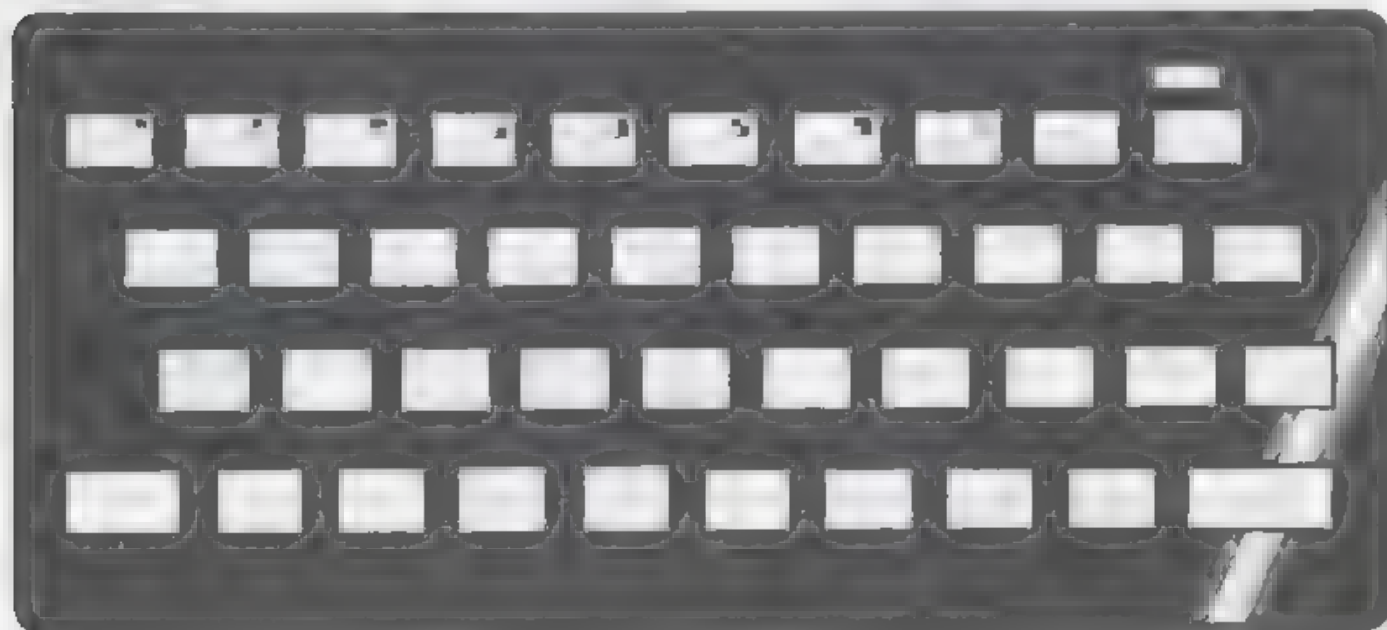
You try

Use the commands BORDER, INK and PAPER to make different colours on the screen.



Graphics characters

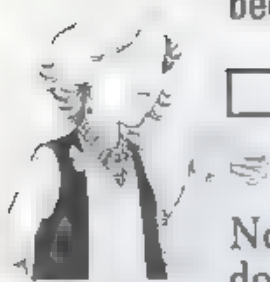
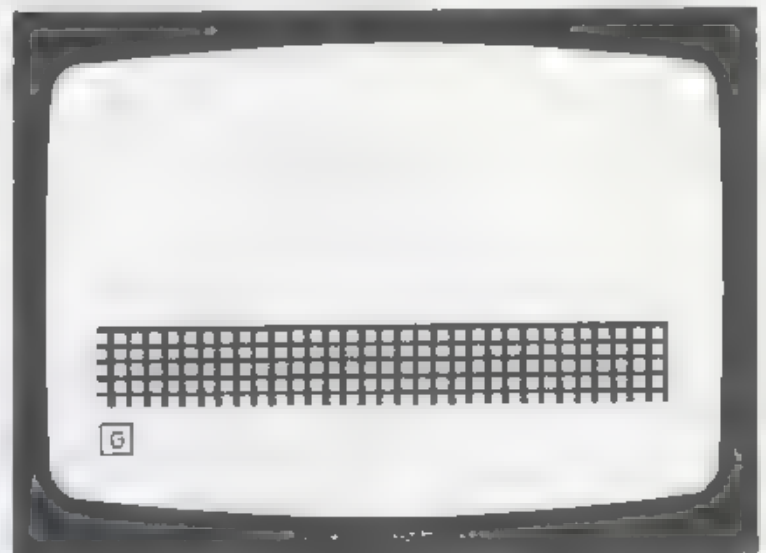
There are 8 graphics characters which are in white on the number keys 1 to 8. To make the computer display them, first go into graphics mode by holding down [CAPS SHIFT] and pressing [9]. The cursor will then change to a flashing [G].



This is what will appear on the screen:

You try

Hold down **[CAPS SHIFT]** and press **[9]** to go into graphics mode. Then hold down key **[7]** until five lines have been filled

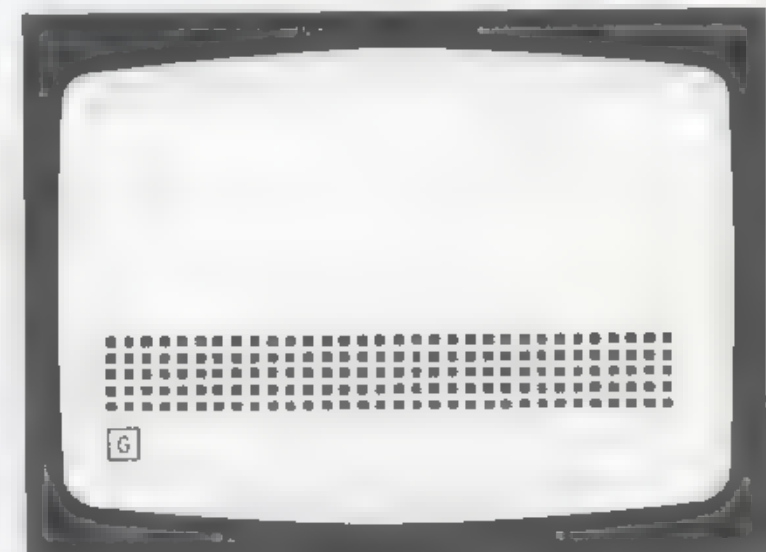


Now press **[9]** to leave graphics mode then press **[EDIT]** (hold down **[CAPS SHIFT]** and press **[1]**) to clear the screen.

This is what will appear on the screen:

You try

Use **EDIT** to clear the screen, then go into graphics mode. Hold down **[CAPS SHIFT]** and press **[7]** until five lines have been filled.



You try

Go into graphics mode and make other patterns by pressing the number keys

You try

Make patterns with the other graphics characters while holding down **[CAPS SHIFT]**.

You try

Use graphics characters to make a picture of a castle, a boat or a train. If you also use extended mode and the number keys you can add colour.



GETTING STARTED



P. C. Truemo

My advice

When you start to make the computer do things for you always check them very carefully. The computer is very exact in the way it understands things. A missing comma, a full stop in the wrong place or a wrong letter will result in the computer not understanding you.

When this happens – INVESTIGATE. Track down every possible mistake until you get everything correct. It may take some time at first to track down your mistakes, but gradually you will not only become quicker at doing this, but you will also make fewer mistakes.

Make notes of the things you find useful, so that you can use them again easily whenever you want. Finally, I find these points very useful.

1. Select the right mode before you press a key.
2. Remember: after every instruction, press ENTER.

Bobby Truemo

In this section you will be shown how to use the computer in four different ways.

1 Using the computer as a typewriter.

You will be shown how to PRINT numbers and characters on the screen and how to space them out in various ways.

2 Using the computer as a calculator.

You will be shown how to add, subtract (or take away), multiply (or times) and divide (or share) numbers using the computer.

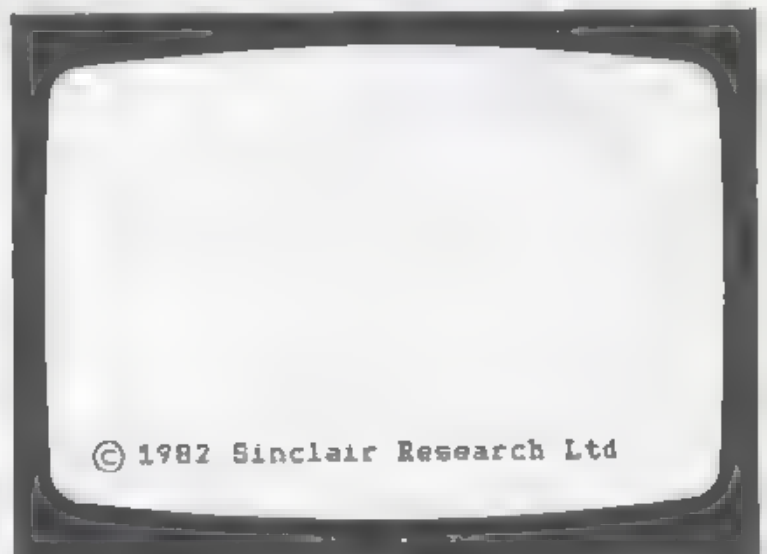
3 Using the computer for storing information.

You will be shown how to put numbers and words into the memory of the computer.

4 Using the computer to ask for information.

You will be shown how to get the computer to ask for information, which it then puts into its memory

When switched on this is what appears on the screen of the ZX Spectrum.





The computer as a typewriter

To make the computer write things we use PRINT. PRINT is on key P.

Printing numbers

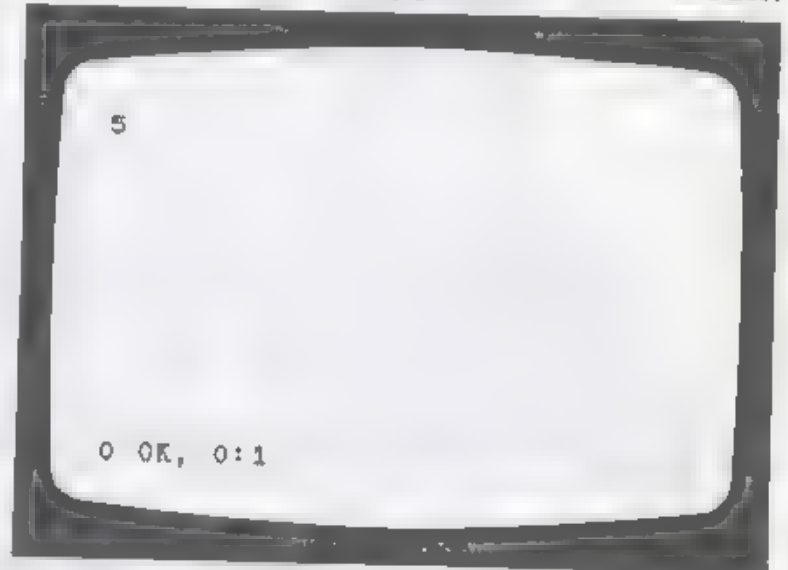
This is what will appear on the screen:

You try

Press **PRINT**, type 5 then press **ENTER**.

Make a note

PRINT is on key P.
To print a number
press **PRINT**
followed by the
number and then
press **ENTER**.



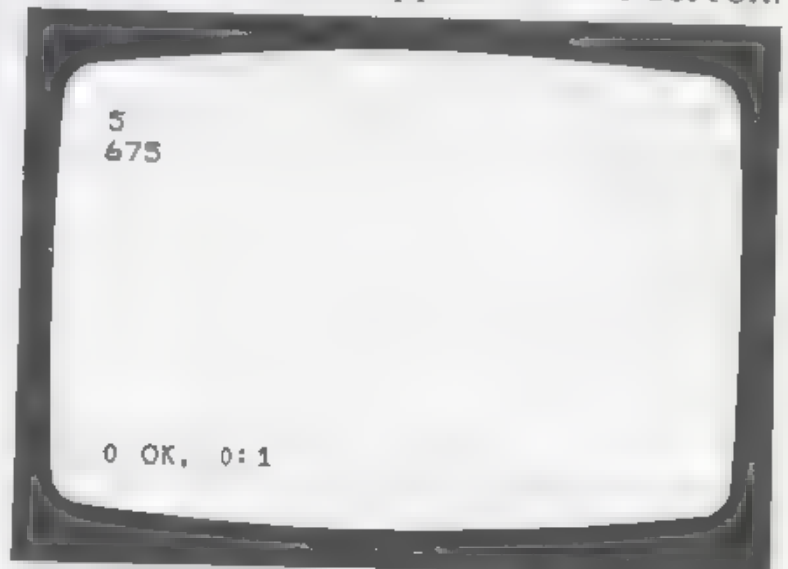
This is what will appear on the screen:

You try

Type **PRINT** 675 then
press **ENTER**.

You try

Using the same idea
PRINT some
numbers of your
own.



Printing symbols, letters and words

This is what will appear on the screen:

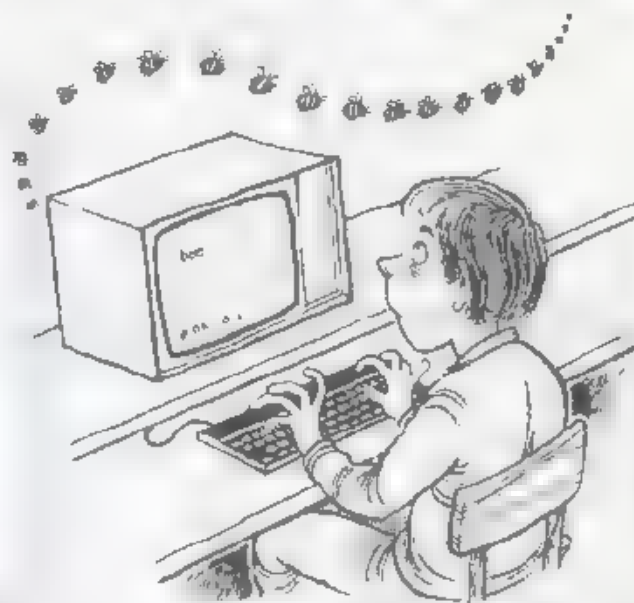
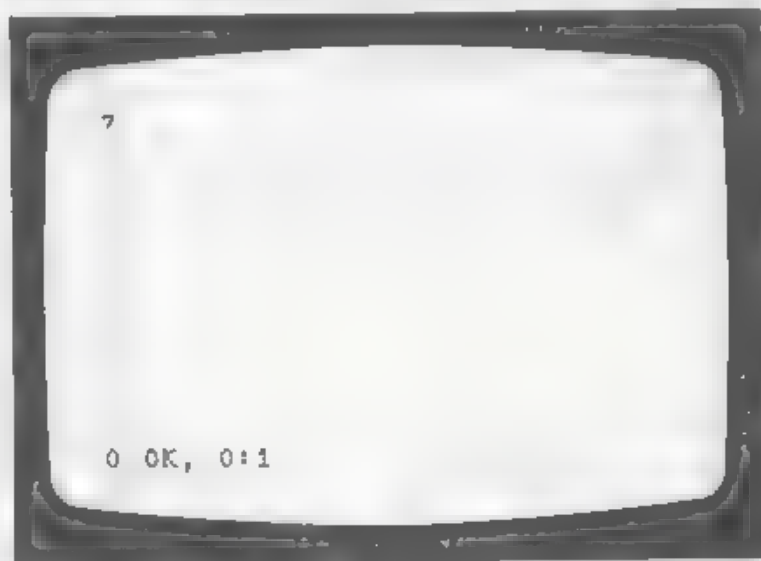
You try

Type **PRINT** "?"
then
press **ENTER**.

Make a note

To print a symbol, letter or word, press **PRINT** followed by the symbol, letter or word inside speech marks, then press **ENTER**.

Remember that if you wish to start again with a clear screen you can press **NEW**. The screens in the book show the new writing which appears.



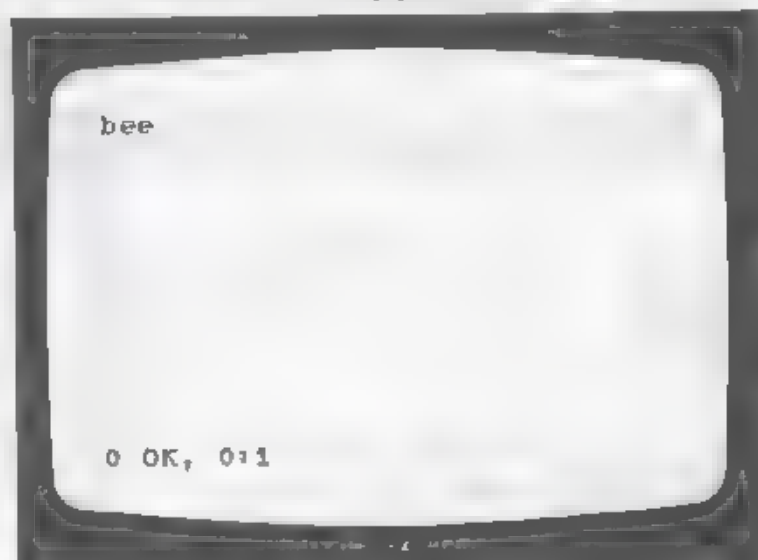
This is what will appear on the screen:

You try

Type **PRINT** "bee"
then press **ENTER**.

You try

Use **PRINT** to make
the computer write
your name





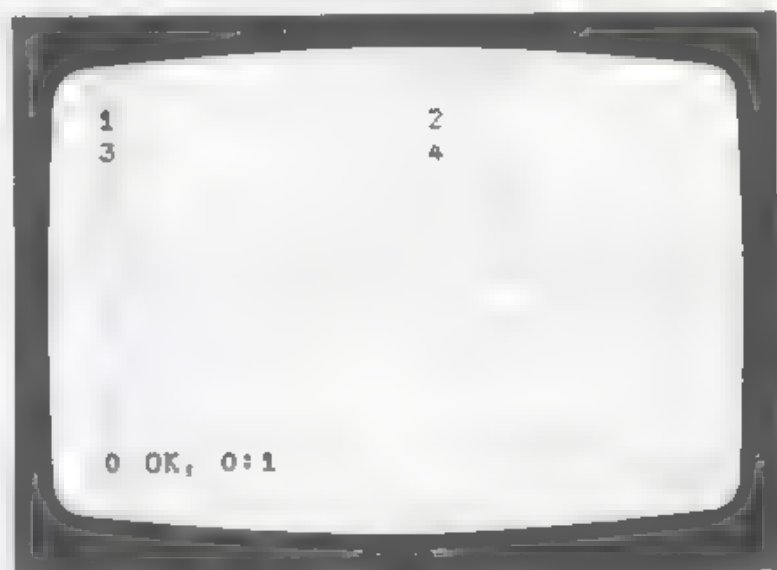
Spacing numbers

This is what will appear on the screen:

You try

Type **PRINT** 1,2,3,4
then press **ENTER**.

*Don't stand and wait,
INVESTIGATE.*



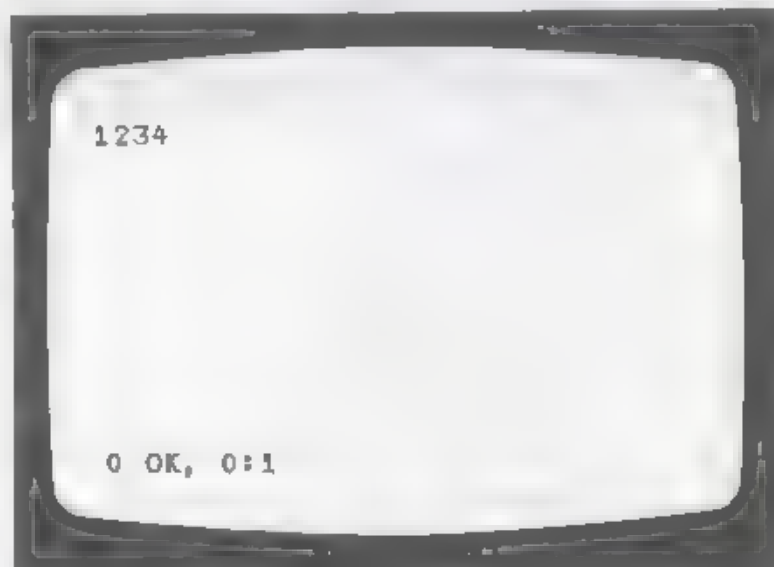
This is what will appear on the screen:

You try

Type **PRINT** 1;2;3;4
then press **ENTER**.

Make a note

The symbol
, prints spaced out
; prints without
spaces
' prints on two lines

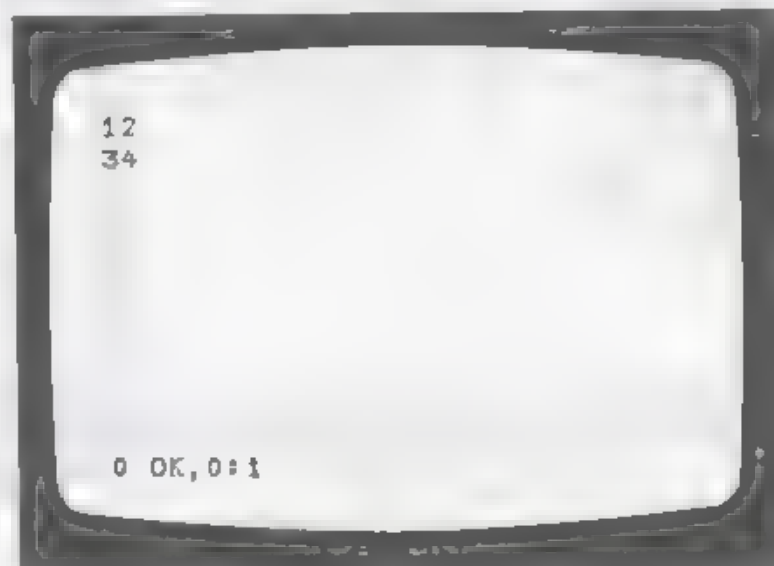


You try

Type **PRINT** 12'34
then press **ENTER**.

Using the same ideas
space out some
numbers of your own.

This is what will appear on the screen:



Spacing words

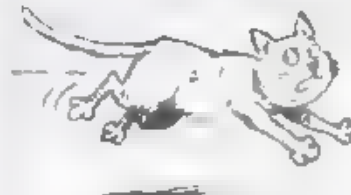
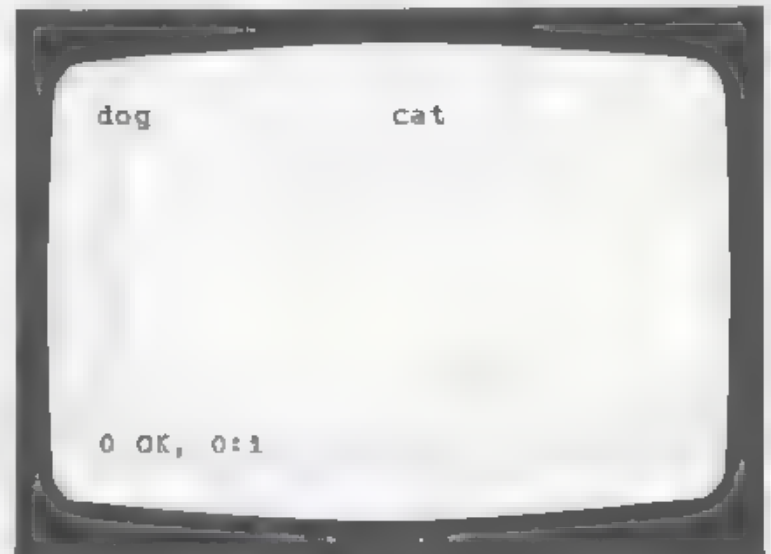


This is what will appear on the screen:

You try

Type

PRINT "dog", "cat"
then press **ENTER**.

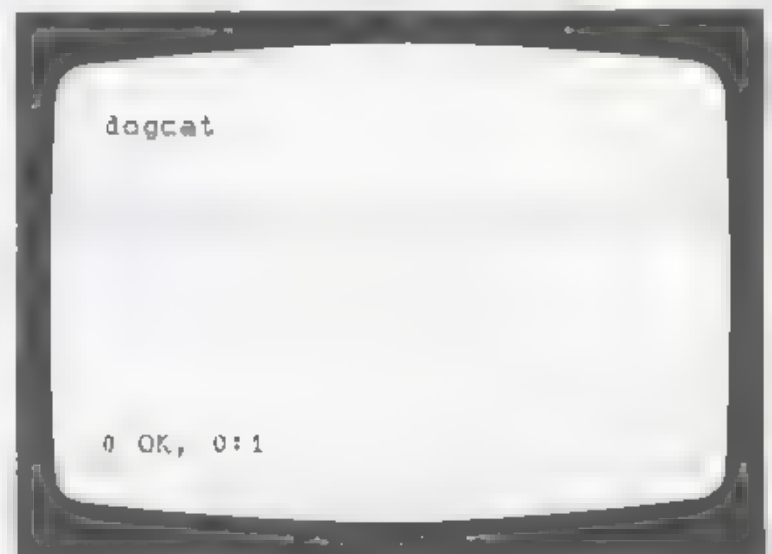


This is what will appear on the screen:

You try

Type

PRINT "dog"; "cat"
then press **ENTER**.



Make a note

The symbol
· prints words
spaced out
; prints words
without spaces
' prints words on
two lines

You try

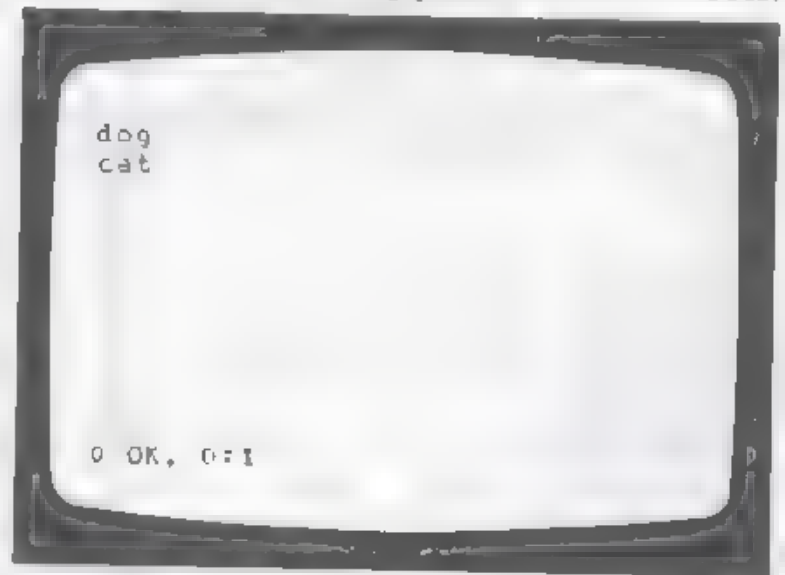
Type

`PRINT "dog" "cat"`
then press `ENTER`.

You try

Using the same idea
space out your first
and second names.

This is what will appear on the screen:



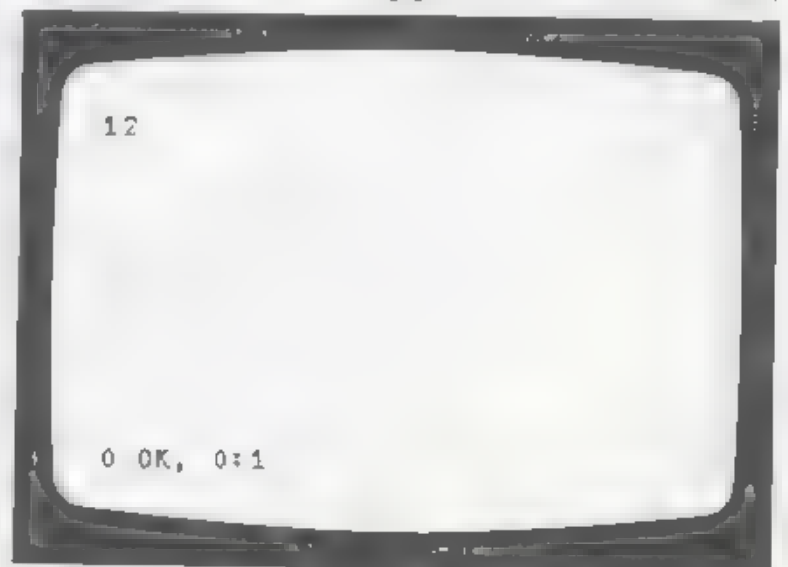
The computer as a calculator

The `PRINT` statement can also be used to make the computer act like a calculator. It can be given a question and it will supply the answer.

This is what will appear on the screen:

You try

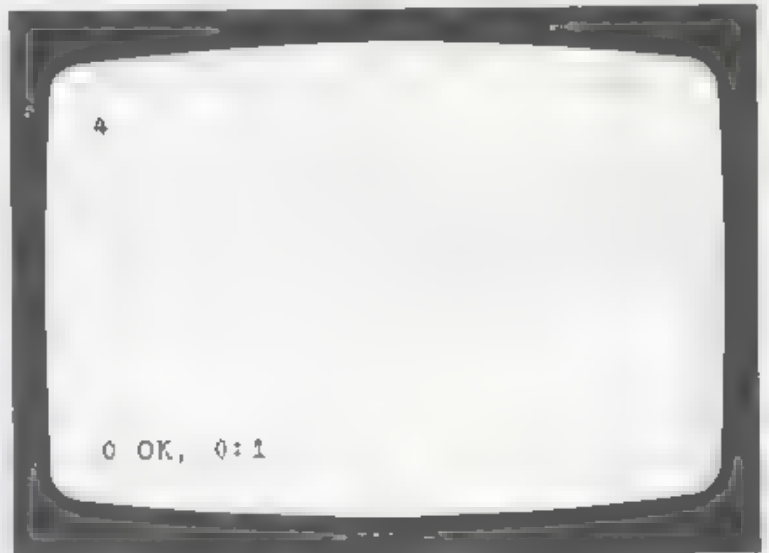
Type `PRINT 5+7`
then press `ENTER`.



This is what will appear on the screen:

You try

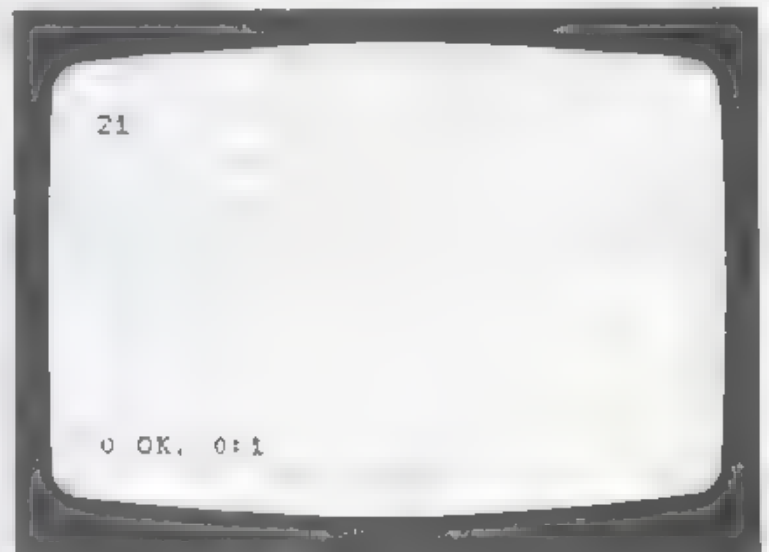
Type **PRINT** 8-4
then press **ENTER**.



This is what will appear on the screen.

You try

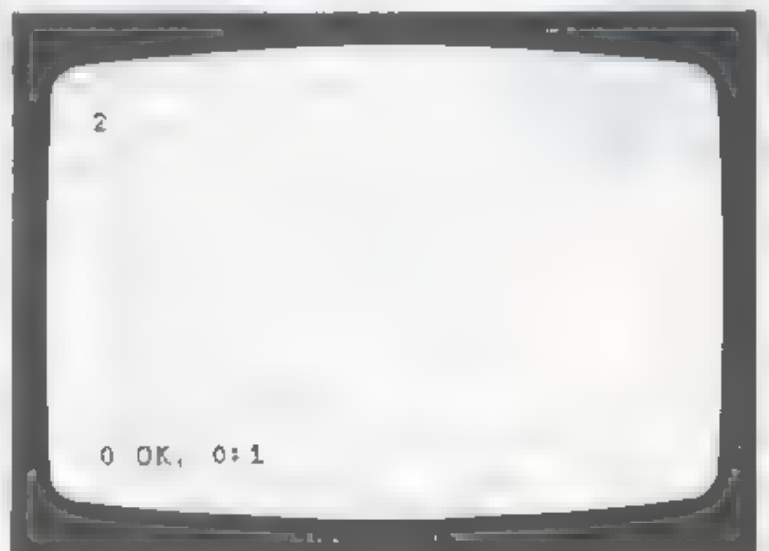
Type **PRINT** 7*3 then
press **ENTER**.



This is what will appear on the screen.

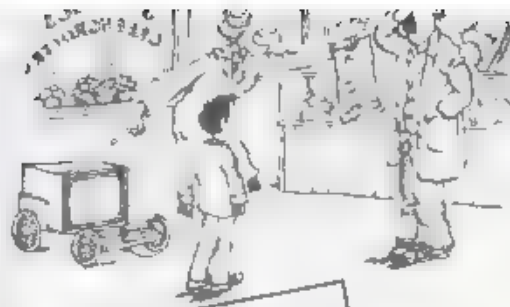
You try

Type **PRINT** 8/4 then
press **ENTER**.



You try

1. Using the same idea make up some of your own sums.
2. Check a shopping bill with the computer.



Make a note

The symbols used are

- + add
- subtract (or take away)
- * multiply (or times)
- / divide (or share)

The computer memory

You can also use the computer to remember information. It is important to know just how the computer does this before you go on to the next part of this section

Just as you live at one address, your friend at another, your teacher at yet another address, so the computer uses a similar system of addresses for storing information.

It stores numbers at the following addresses in its memory. The addresses can be either letters or words. For example



or



It stores words at addresses like these.



Make a note

The computer uses a, b, c, d etc for addresses to store numbers and uses a\$, b\$, c\$, d\$ etc. for addresses to store words.



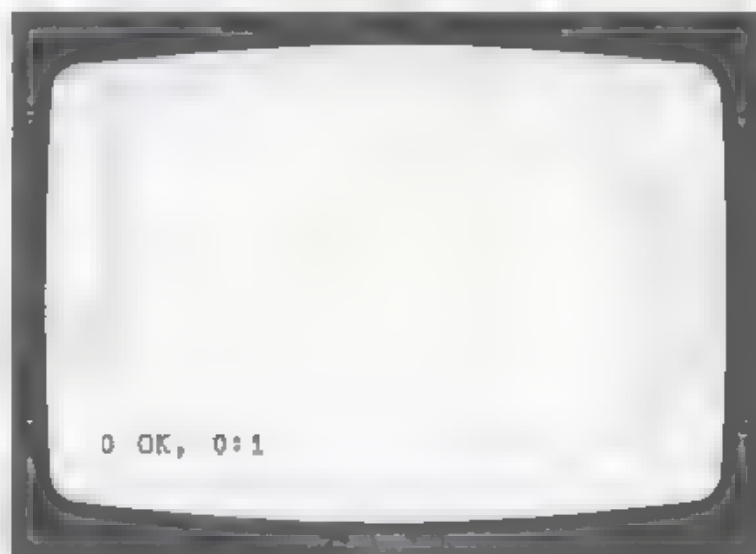
Using the computer to store information

The LET statement is used to put numbers or words into the memory of the computer. LET is on key L.

This is what will appear on the screen:

You try

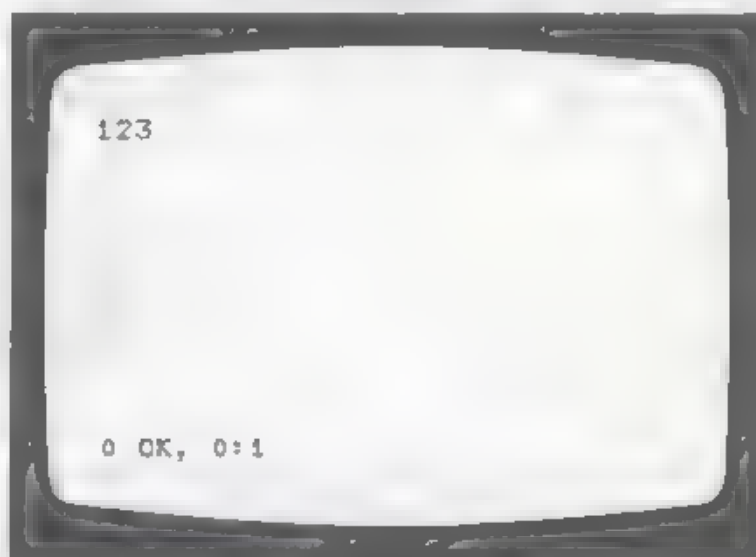
Type **LET** a=123
then press **ENTER**.



This is what will appear on the screen:

You try

Type **PRINT** a then
press **ENTER**.



LET a 123 put the number 123 into the memory of the computer at address a. PRINT a recalled the number which was in the memory of the computer at address a.

You try

Using the LET statement put the number 12 into address b and number 4 into address c. Then type **PRINT** b+c' b-c' b*c' b/c.

Make a note

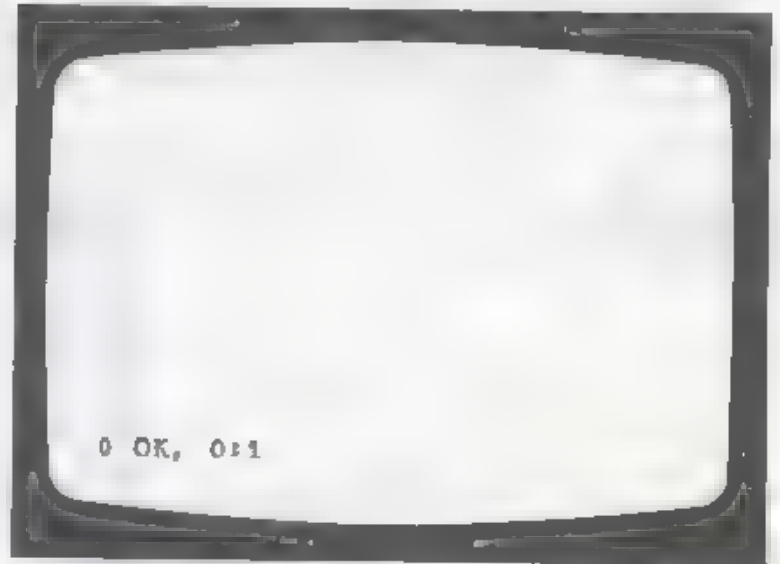
LET is on key L

This is what will appear on the screen:

You try

Type

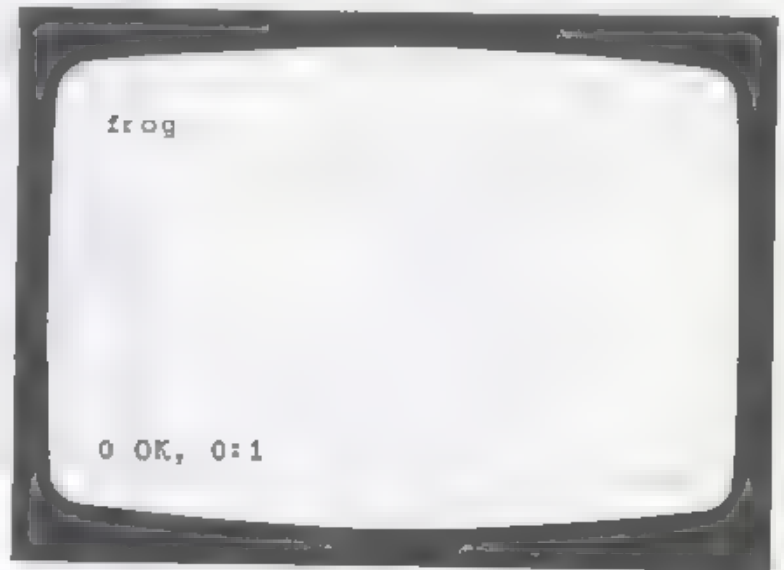
LET a\$="frog"
then press **ENTER**.



This is what will appear on the screen:

You try

Type **PRINT** a\$ then
press **ENTER**.



LET a\$="frog" put the word good into the memory of the computer at address a\$. PRINT a\$ recalled the word which was in the memory of the computer at address a\$.

You try

Use the LET statement to put "I" in the address b\$, "am" in the address c\$, and "a" in d\$. Type

PRINT d\$, a\$, c\$, b\$
and press **ENTER**.

Type **PRINT** b\$, c\$,
d\$, a\$ and press **ENTER**.





Using the computer to ask for information

The INPUT statement is used to make the computer ask for numbers or words which it then puts into a memory address. INPUT is on key I.

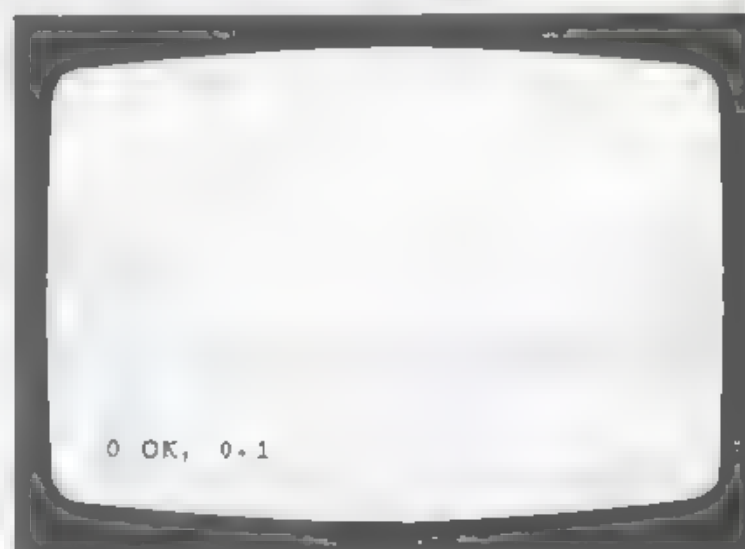
This is what will appear on the screen:



You try

Type **INPUT** a
then press **ENTER**.

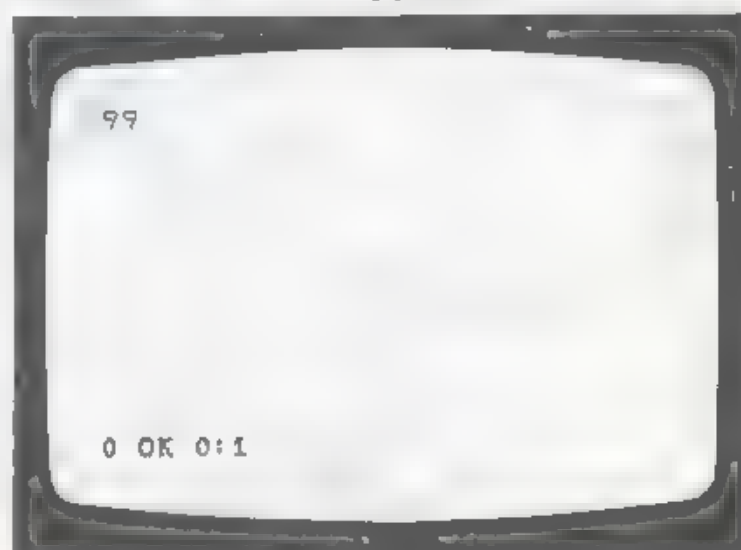
This is what will appear on the screen:



You try

Type 99 then press
ENTER.

This is what will appear on the screen.



You try

Type **PRINT** a
then press **ENTER**.





INPUT a made the computer ask for a number. When the number 99 was typed, the computer put 99 into the memory address a. PRINT a recalled the number which was in the memory of the computer at address a.

You try

Use the INPUT statement to make the computer ask for some numbers to put into the computer memory addresses b and c. ([L] is asking for a number). Type [PRINT] b,c,b+c,b*c.

Make a note

1. INPUT is on key 1
2. INPUT a makes the computer ask for a number.
3. [L] is the way the computer asks for a number.
4. The number the computer is given goes into the memory address a.

You try

Type [INPUT] a\$ then press [ENTER].

This is what will appear on the screen:



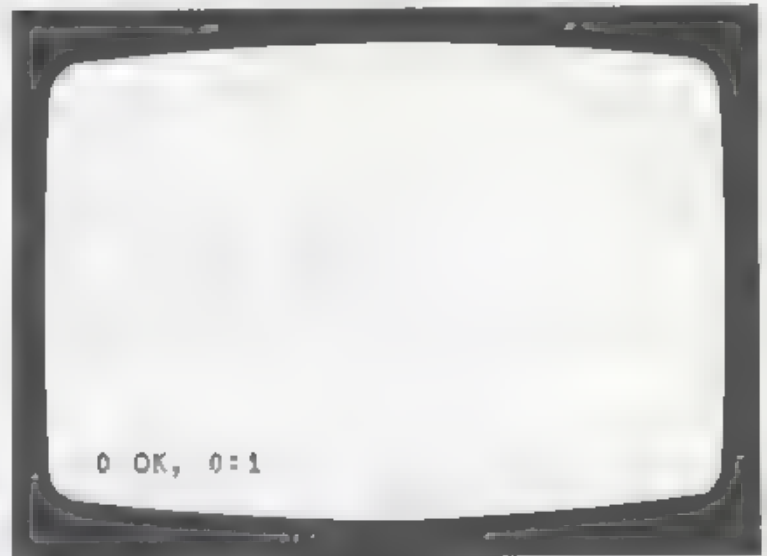
If remembering numbers is a bore, INPUT can be used to store

This is what will appear on the screen:

You try

Type hello then press

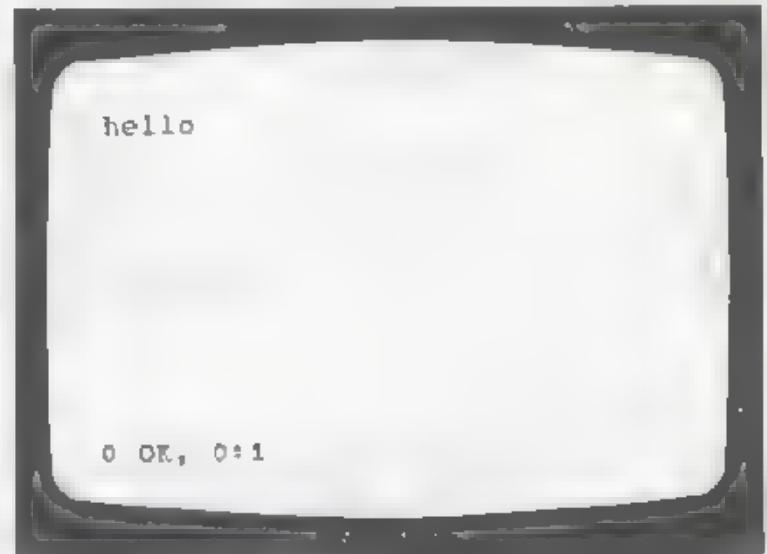
ENTER.



You try

Type **PRINT** a\$ then press **ENTER**.

This is what will appear on the screen:



INPUT a\$ made the computer ask for a word. When the word 'hello' was typed in, the computer put 'hello' into the memory address a\$. **PRINT** a\$ recalled the word which was in the memory address a\$.

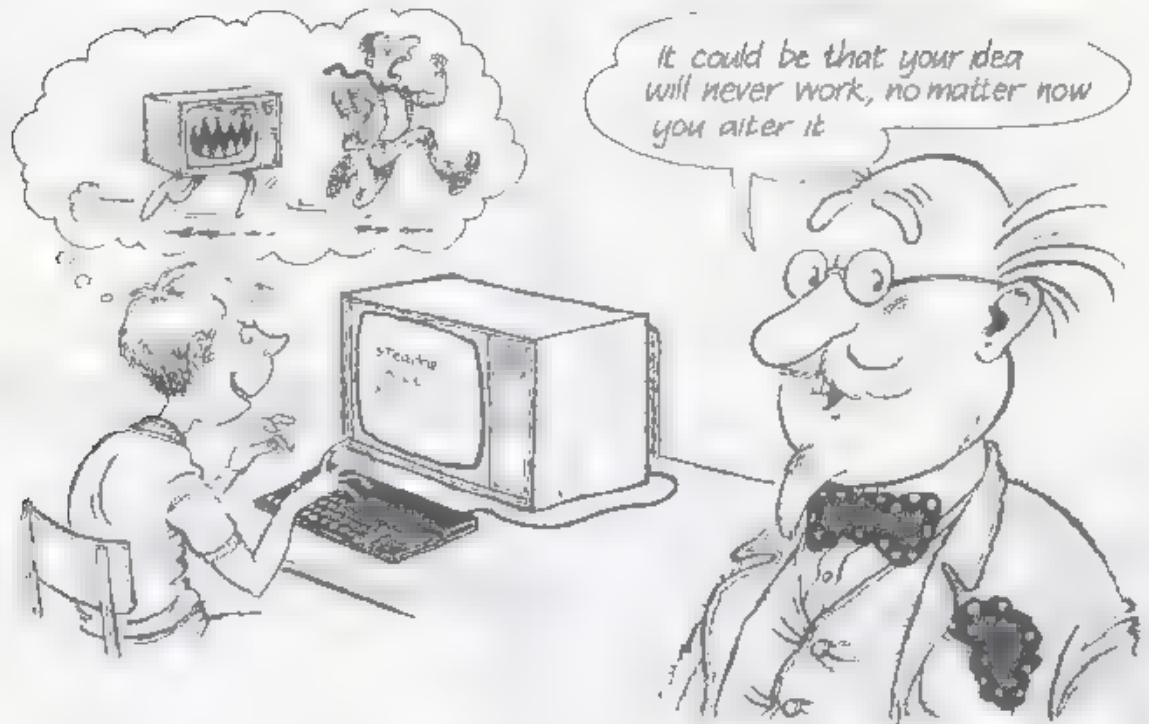
You try

Use the **INPUT** statement to put your name into the address b\$. ("L" is asking for a word.) Type **PRINT** a\$,b\$

Make a note

1. **INPUT** a\$ makes the computer ask for a word.
2. "L" is the way the computer asks for a word.
3. The word given then goes into memory address a\$.

WRITING PROGRAMS



Prof. O. Crumpet

My advice

You want ideas that work. You will probably need to spend some time thinking about them. If your idea does not work as you thought it would, then try to find out why. It may be that one very small alteration will make it work exactly as you intended.

However, it could be that your idea will never work, no matter how you alter it, so be prepared at times to start all over again. Sorting out ideas is not easy, but it is easier if you have some plan to work to.

Often an idea does not work quite as you wanted, but it could be used in another way. Make a note of it so that you can use it later. You must, of course, keep a very careful record of all your really good ideas.

Oliver Crumpet

The computer can do many things. Here are just a few. Try them for yourself.

CLS (on key V) followed by **ENTER** gives a blank screen.

PRINT "computer" (followed by **ENTER**) gives the word 'computer'.

PRINT "programmer" (followed by **ENTER**) gives the word 'programmer'.

The computer can be given many other things to do, but instead of giving them to the computer one at a time, they can be given together. When the computer is given a list of things to do in order it is called a computer program. The lines begin with line numbers to tell the computer the order in which they should be carried out. Examples of line numbers are: 10 20 30 40 50 etc.

The computer looks at the list and works through it 10, 20, 30, 40, 50 in order until it reaches the end. Some programs have just a few line numbers, other programs may have hundreds or even thousands. An example of a program is:

```
10 PRINT
20 PRINT "computer"
30 PRINT
40 PRINT "programmer"
50 PRINT
```

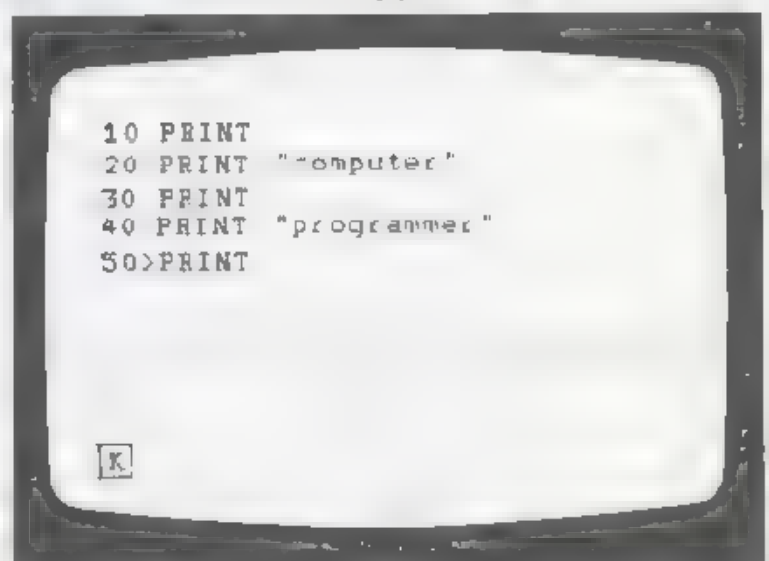
*You are making a start,
At the programming art.*



You try

Type the program above, line by line. After you have written each line press **ENTER**.

This is what will appear on the screen:

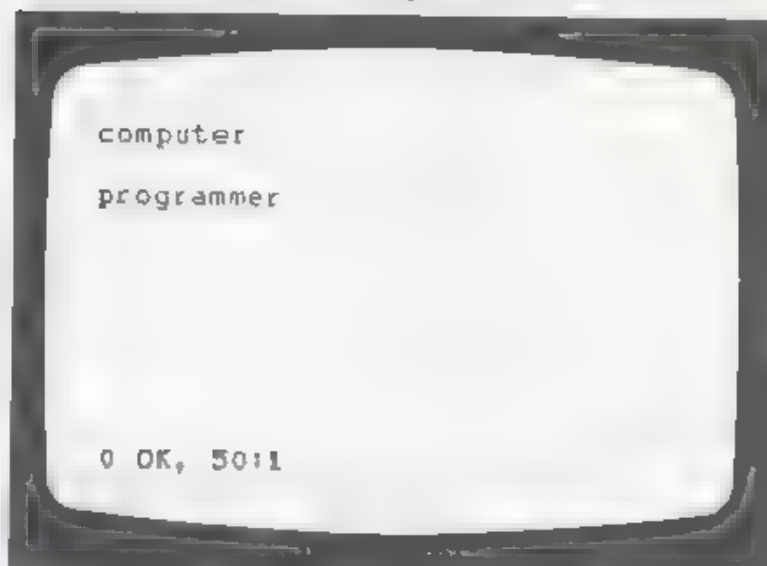




You try

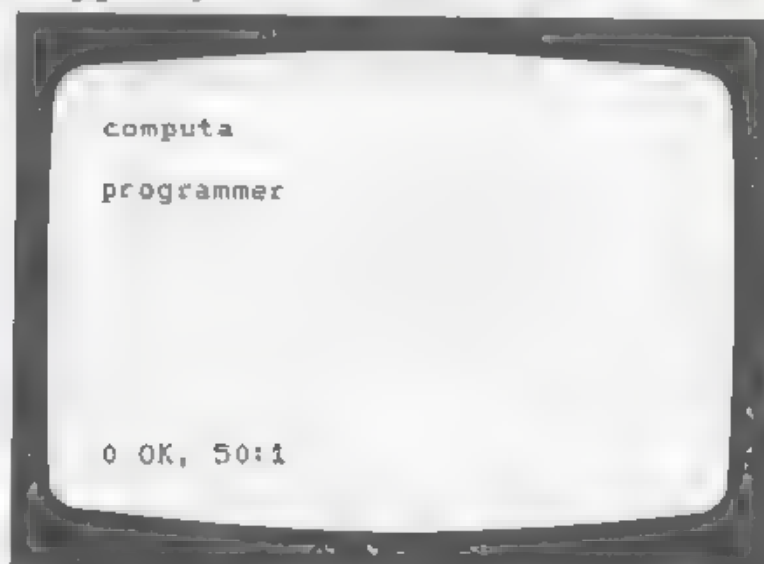
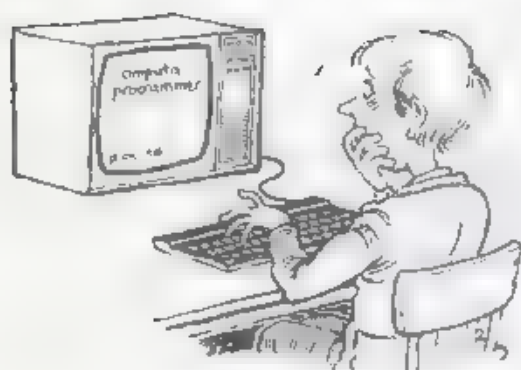
Now press **RUN** (on key R) then **ENTER**.

This is what will appear on the screen:



PRINT on a line by itself gives a blank line.
If you have made any mistakes you can correct them by re-typing the line in which they occur.

Suppose your screen showed:



The mistake is in line number 20, so by re-typing the line number 20 this mistake can be corrected.

20 **PRINT** "computer" (followed by **ENTER**).

This will correct the line in the program and give you the correct display.

You may also alter lines in the program in the same way.
Type in the following.

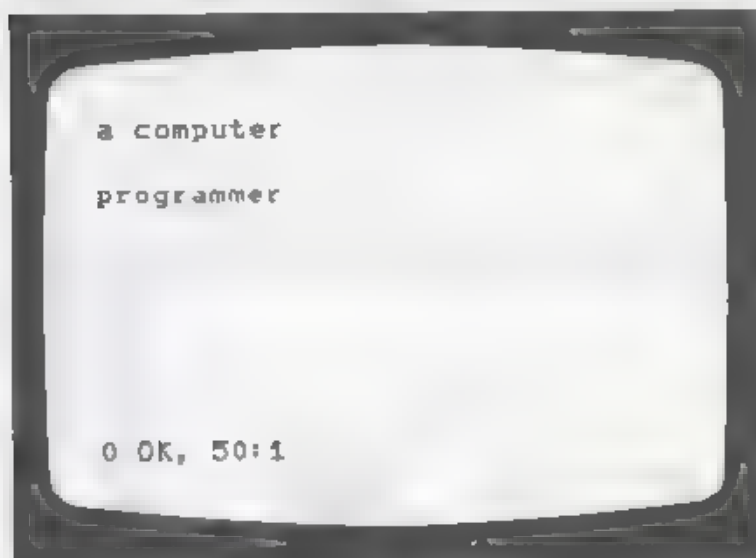
20 **PRINT** "a computer" (followed by **ENTER**).

This will alter the line in the program.

Now press **RUN** and **ENTER**.



This is what will appear on the screen:



The program line numbers go up in tens so it is possible to add extra lines. For example, suppose we wish to add 'I am'. First press **LIST** (on key K) then **ENTER** to look at the program. Then type

5 **PRINT** "I am" (followed by **ENTER**).

This puts the line into the program as follows.

5 **PRINT** "I am"

10 **PRINT**

20 **PRINT** "a computer"

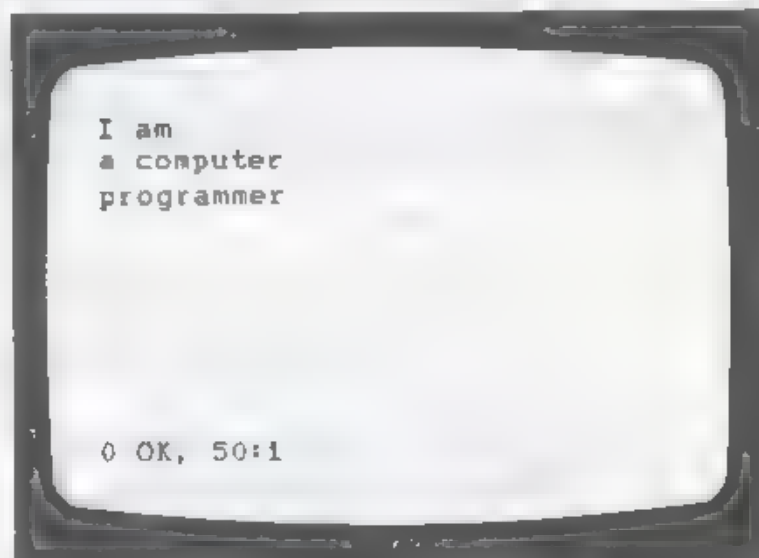
30 **PRINT**

40 **PRINT** "programmer"

50 **PRINT**

Press **RUN** then **ENTER**.

This is what will appear on the screen:



Make a note

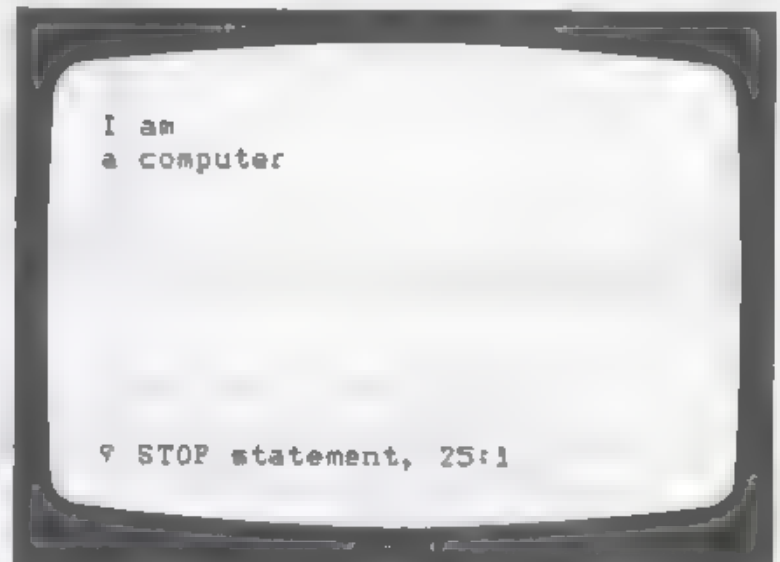
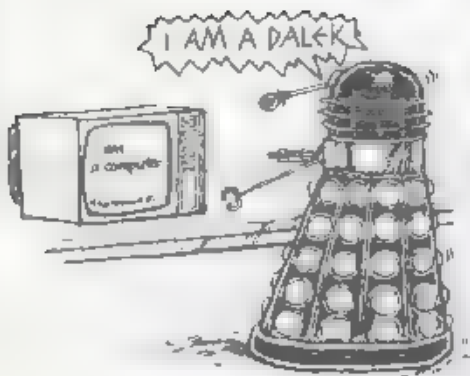
1. Number each line 10, 20, 30 etc.
2. Press **ENTER** when each line is complete.
3. Press **RUN** (on key R) then **ENTER** when the program is complete.
4. Correct mistakes by re-typing the line.
5. Press **LIST** (on key K) then **ENTER** to look at the program.

You can make the computer stop by using the command STOP (hold down **SYMBOL SHIFT** and press **A**). Add the following line to your program.

25 **STOP**

Press **RUN** then **ENTER**.

This is what will appear on the screen:



Your own programs

In order to write your own programs you need to find out just what the computer can do. The exercises which follow should help you.

Before you start the next section you need to have understood the last section. If you are at all unsure about anything, work through it again.

Type in these programs just as the earlier program was typed in, that is one line at a time followed by **ENTER** to get to the start of the next line. Check your program when it has all been typed in and correct any mistakes by re-writing the faulty line. When you are sure that the program is complete and correct, press **RUN** then **ENTER** and see what happens.

So that the computer does not get one program confused with the next, press **NEW** (on key A) then **ENTER** before typing in a new program. The computer then forgets the old program.

When you have copied and run the programs in each section, try the exercises. If you come up with any ideas for similar programs, try them out and see how they work.

At the end of this chapter and the next one, there are some projects which are ideas for longer and more interesting programs. For most of the projects, you are helped with writing the basic program, and then you are given some ideas to improve it.

PRINT (on key P) is used to print out lists, information, diagrams and instructions.

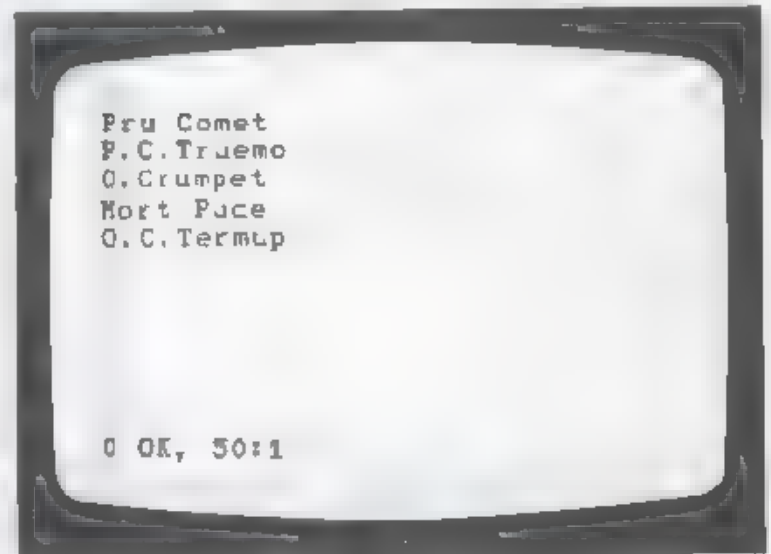
This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.
Type in the following program.

```
10 PRINT "Pru Comet"
20 PRINT "P. C. Truemo"
30 PRINT "O. Crumpet"
40 PRINT "Mort Puce"
50 PRINT "O. C. Termup"
```

Press **RUN** then **ENTER**.



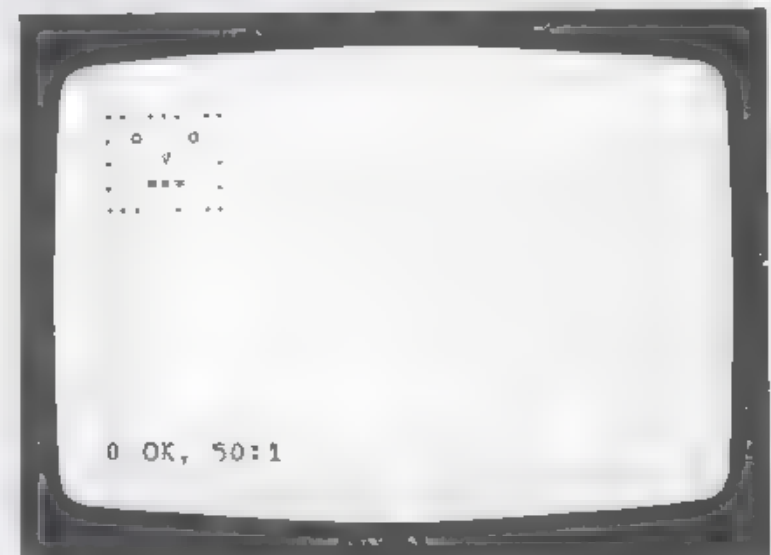
You try

Press **NEW** then **ENTER**.
Type in the following program.

```
10 PRINT " . . . . . "
20 PRINT " . 0 0 "
30 PRINT " . V "
40 PRINT " . == "
50 PRINT " . . . . . "
```

Press **RUN** then **ENTER**.

This is what will appear on the screen:



You try

Make up your own programs using PRINT to do the following:

1. Write out a shopping list.
2. Design a motorway sign.
3. Draw a space shuttle.





TAB (key P in extended mode) is used to set out information or diagrams.

This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.

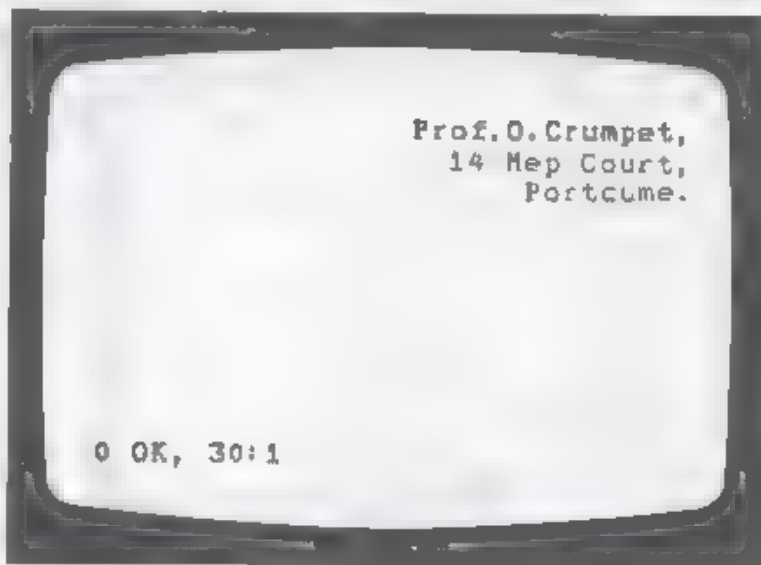
Type in the following program.

10 **PRINT** **TAB** 12; "Prof. O.
Crumpet,"

20 **PRINT** **TAB** 15; "14 Mep
Court,"

30 **PRINT** **TAB** 18; "Portcume."

Press **RUN** then **ENTER**.



You try

Press **NEW** then **ENTER**.

Type in the following program.

10 **PRINT** **TAB** 16; "*"

20 **PRINT** **TAB** 15; "****"

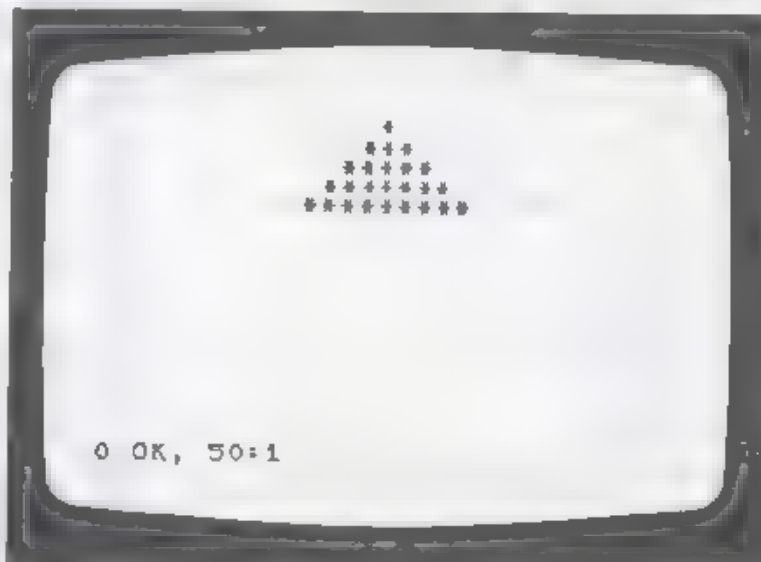
30 **PRINT** **TAB** 14; "*****"

40 **PRINT** **TAB** 13; "*****"

50 **PRINT** **TAB** 12; "*****"

Press **RUN** then **ENTER**.

This is what will appear on the screen:



You try

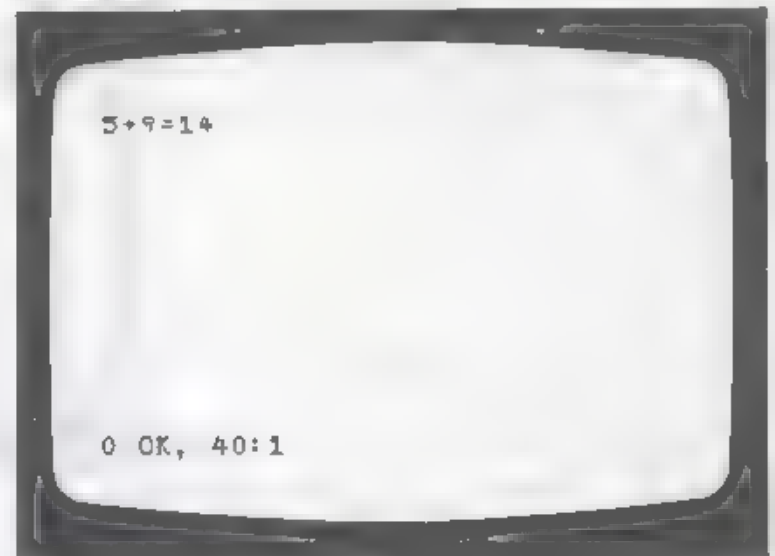
Make up your own programs using TAB to do the following.

1. Draw a staircase
2. Set out your address.
3. Draw a sloping line.



LET (on key L) is used to put a number into an address.

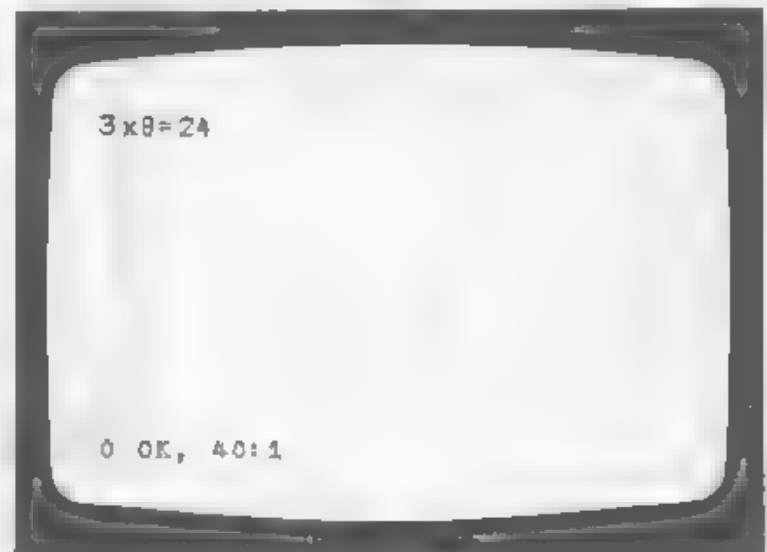
This is what will appear on the screen.



You try

Press **NEW** then **ENTER**.
Type in the following program.
10 **LET** a=5
20 **LET** b=9
30 **LET** sum=a+b
40 **PRINT** a;"+";b;"=";sum
Press **RUN** then **ENTER**.

This is what will appear on the screen:



You try

Press **NEW** then **ENTER**.
Type in the following program.
10 **LET** e=3
20 **LET** f=8
30 **LET** product=e*f
40 **PRINT** e;"x ";f;"=";product
Press **RUN** then **ENTER**.

You try

Make up your own programs using LET to do the following.

1. Add two other numbers.
2. Multiply two other numbers.
3. Subtract or divide numbers.

To see what's done
Just press RUN



LET is also used to put words in addresses.

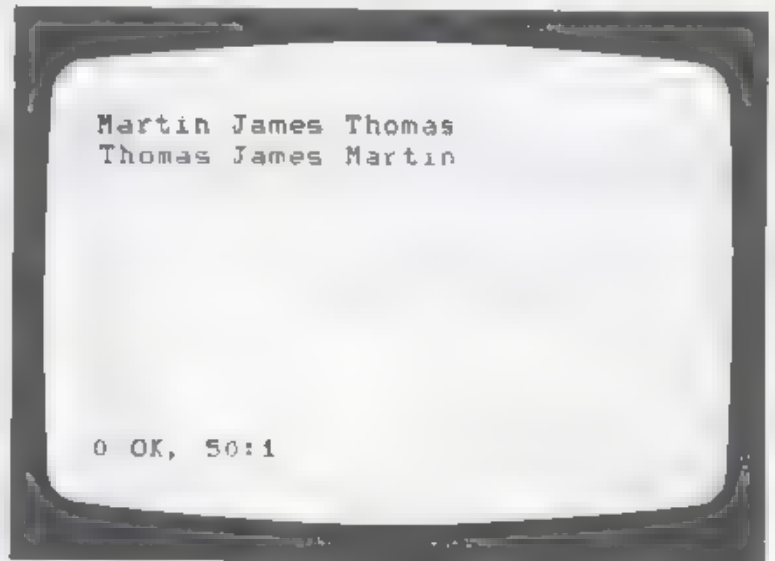
This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 LET a$="Martin"
20 LET b$="James"
30 LET c$="Thomas"
40 PRINT a$;" ";b$;" ";c$
50 PRINT c$;" ";b$;" ";a$
Press RUN then ENTER.
```



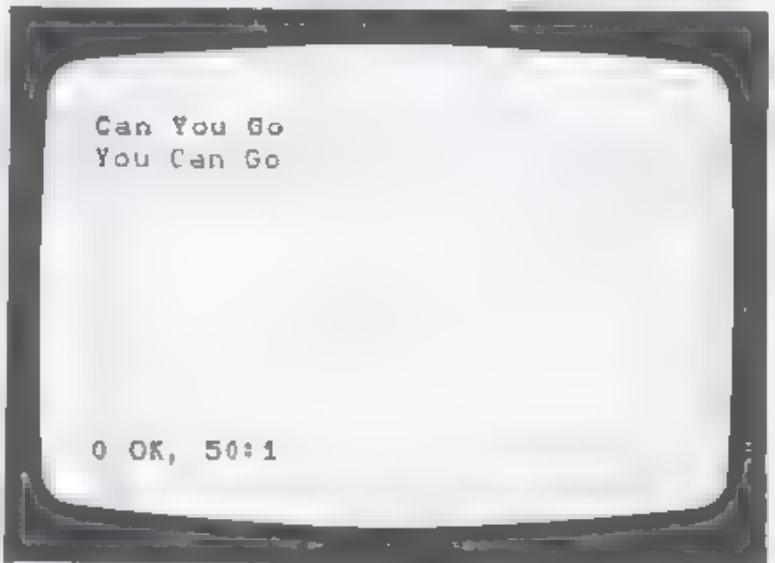
You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 LET a$="Can"
20 LET b$="You"
30 LET c$="Go"
40 PRINT a$;" ";b$;" ";c$
50 PRINT b$;" ";a$ " ";c$
Press RUN then ENTER.
```

This is what will appear on the screen.



You try

Make up your own programs using LET to do the following.

1. Make a\$="in", b\$="on", c\$="set", d\$="side", e\$="to", f\$="up", g\$="wards". By putting these words together, see how many longer words you can print.
2. Make some sentences from words
3. Select items from a restaurant menu.



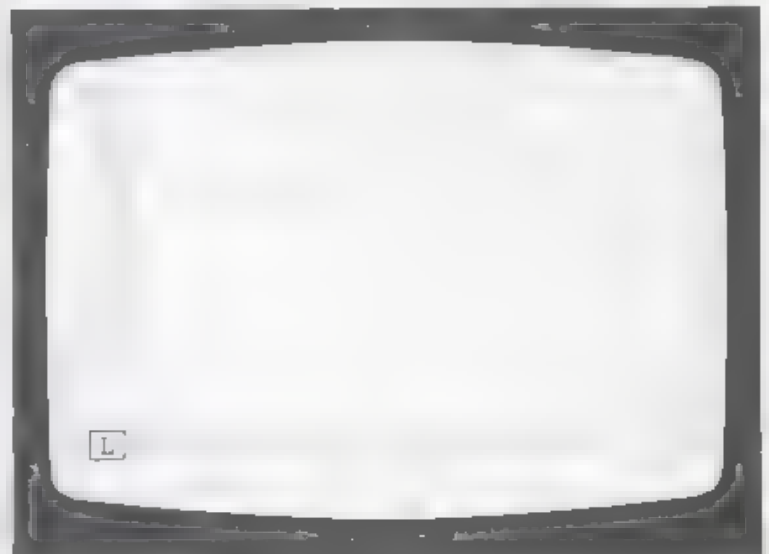
INPUT (on key I) is used to put numbers into programs.

This is what will appear on the screen:

You try

Type **NEW** then press **ENTER**.
Type in the following program.

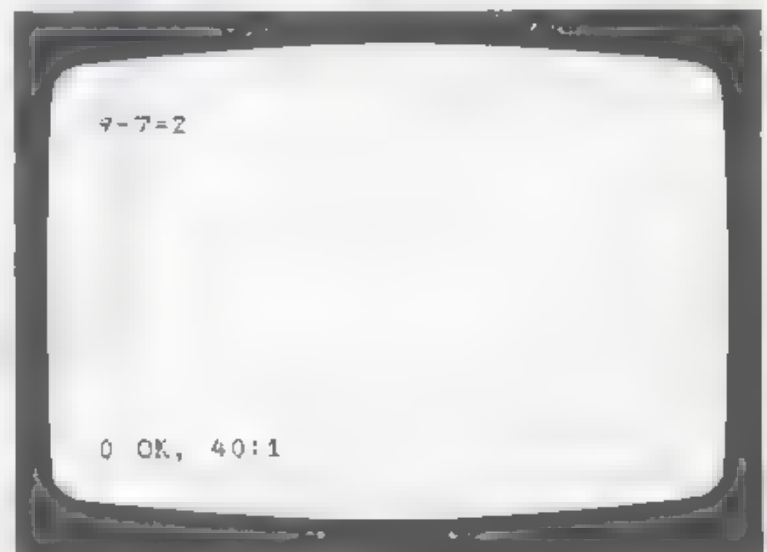
```
10 INPUT a
20 INPUT b
30 LET diff=a-b
40 PRINT a; "-"; b; "="; diff
Press RUN then ENTER.
```



This is what will appear on the screen:

You try

Type in a number,
for example 9, then
press **ENTER**.
Type in a number,
for example 7, then
press **ENTER**.



You try

Press **RUN** then **ENTER**.
Now put your own numbers into the
program.



You try

Press [NEW] then [ENTER].

Type in the following program.

```
10 INPUT "First number?";n
20 INPUT "Second number?";d
30 LET quotient=n/d
40 PRINT n;" / ";d; "=";quotient
Press [RUN] then [ENTER].
```

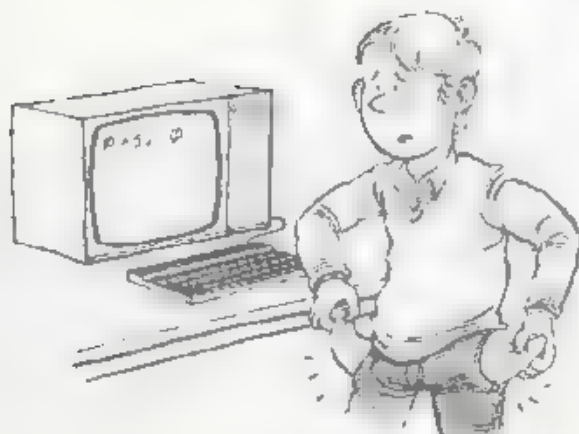
You try

Type in a number, for example 8,
then press [ENTER].

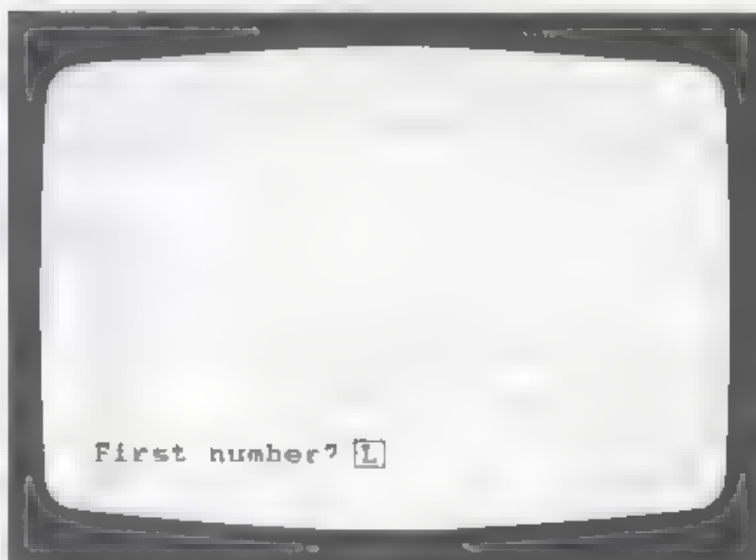
Type in a number, for example 4,
then press [ENTER].

You try

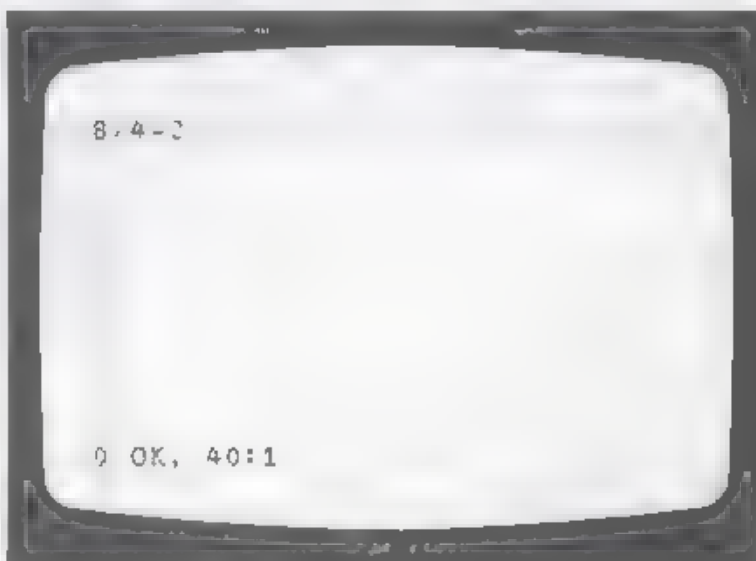
Press [RUN] then [ENTER]. Now put
your own numbers into the
program.



This is what will appear on the screen:



This is what will appear on the screen:



You try

Make up your own programs using
INPUT to do the following.

1. Add two numbers together.
2. Multiply two numbers.
3. Ask for the amount of pocket money you receive in a week and multiply this by 52 to give the amount you receive in a year.

INPUT is also used to put words into programs.

This is what will appear on the screen

You try

Press **NEW** then **ENTER**

Type in the following program.

10 **PRINT** "Ann, Eve, Kate, Mary"

20 **PRINT** "Find the palindrome"

30 **INPUT** a\$

40 **PRINT** "The palindrome is Eve."

50 **PRINT** "Your answer is ";a\$

Press **RUN** then **ENTER**.

```
Ann, Eve, Kate, Mary
Find the palindrome
?_
```

"L"



This is what will appear on the screen

You try

Type in the
palindrome Eve then
press **ENTER**.

```
Ann, Eve, Kate, Mary
Find the palindrome
The palindrome is Eve
Your answer is Eve
```

0 OF 5 : 1



(A palindrome is a word which is spelt the same way
backwards as forwards.)

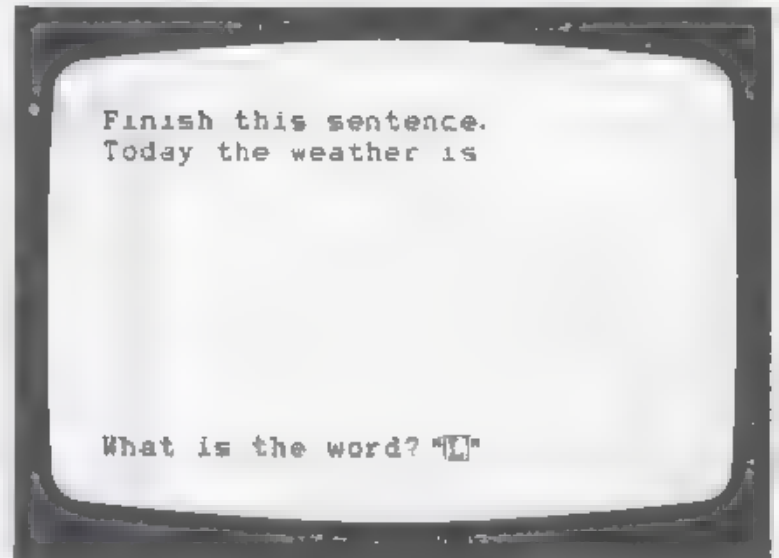
This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.

Type in the following program.

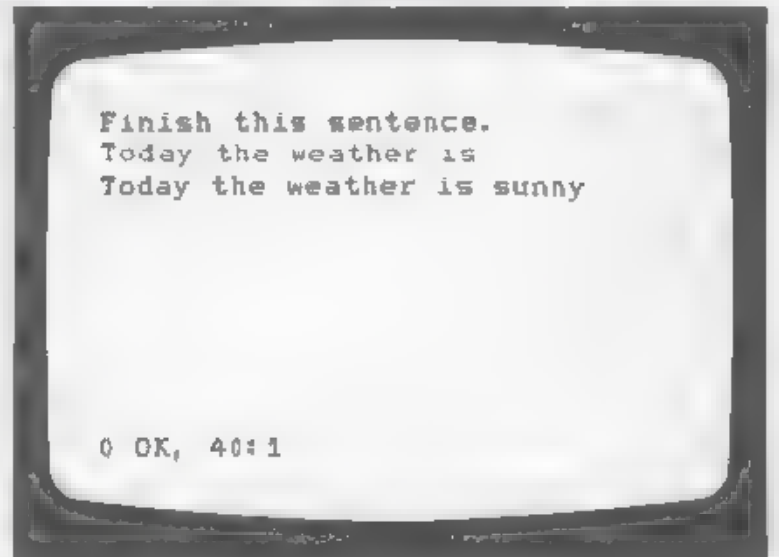
```
10 PRINT "Finish this sentence."  
20 PRINT "Today the weather is"  
30 INPUT "What is the word?";a$  
40 PRINT "Today the weather  
is ";a$
```



This is what will appear on the screen:

You try

Type in sunny (or another word to describe the weather) then press **ENTER**.



You try

Make up your own programs using **INPUT** to do the following.

1. Find a missing word.
2. Answer a simple question.
3. Make the computer have a conversation with you.



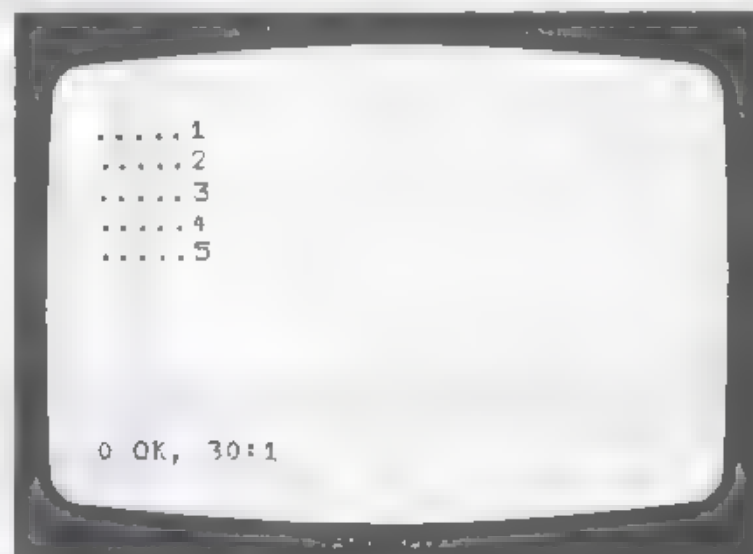


Programs using FOR/TO/STEP/NEXT

Spectrum manual 31

FOR/TO/STEP/NEXT are used to repeat the same lines in turn for a set of numbers. FOR is on key F. TO is on key F with symbol shift. STEP is on key D with symbol shift. NEXT is on key N.

This is what will appear on the screen:

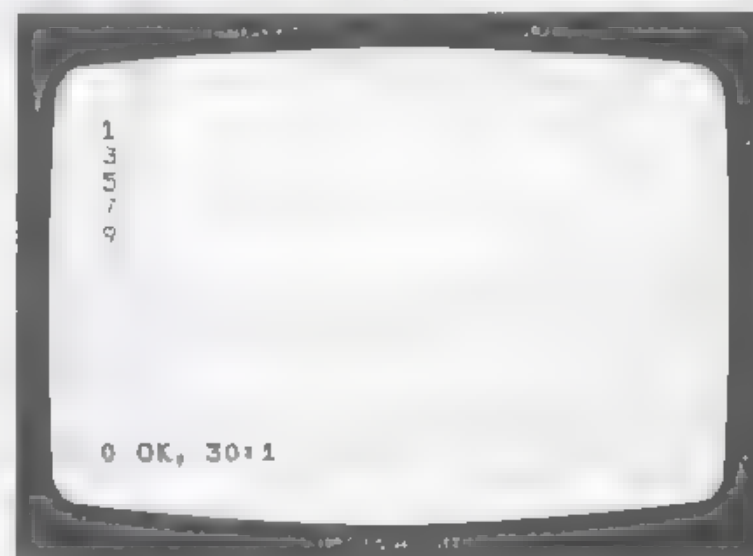


You try

Press [NEW] then [ENTER].
Type in the following program.
10 [FOR] c=1 TO 5 [STEP] 1
20 [PRINT] ".....";c
30 [NEXT] c
Press [RUN] then [ENTER].

For each value of the count c between 1 and 5, the row of dots and the value of the count c was printed.

This is what will appear on the screen:



You try

Press [NEW] then [ENTER].
Type in the following program.
10 [FOR] n=1 [TO] 9 [STEP] 2
20 [PRINT] n
30 [NEXT] n
Press [RUN] then [ENTER].

You try

Make up your own programs using FOR/TO STEP NEXT as follows.

1. Print out the numbers 1 to 20.
2. Print out your name and address three times.
3. Print out the three times table

If you do not tell the computer the size of the step it assumes "STEP 1", so we could have left this out in the first example.



DATA, READ are used to put data (information) into the computer and read (recall) it when it is needed. DATA is on key D in extended mode. READ is on key A in extended mode.

You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 DATA "is ", "clue ", "a ",  
"here "
```

```
20 READ w$, x$, y$, z$
```

```
30 PRINT z$; w$; y$; x$
```

```
40 PRINT y$; x$; w$; z$
```

Press **RUN** then **ENTER**.

You try

Type in the following program which, for each of five pupils, reads in their maths mark and English mark and works out the average.

```
10 DATA 75, 61, 83, 79, 64, 78,  
93, 67, 86, 72
```

```
20 FOR p=1 TO 5
```

```
30 READ maths, English
```

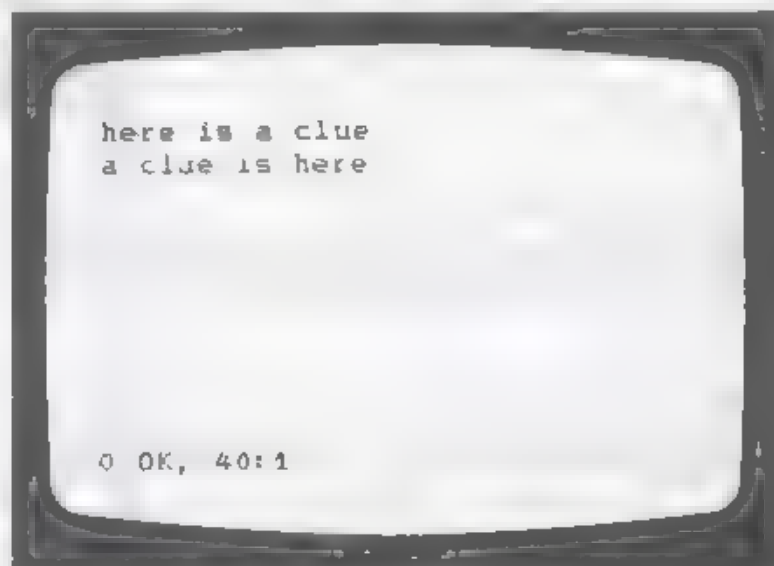
```
40 LET average =  
(maths + English)/2
```

```
50 PRINT "pupil ";p;" has an  
average of "; average
```

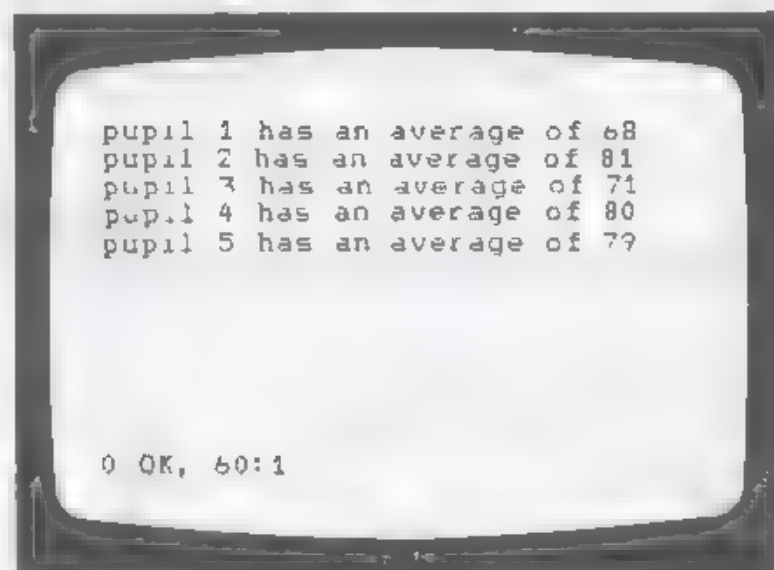
```
60 NEXT p
```

Press **RUN** then **ENTER**.

This is what will appear on the screen:



This is what will appear on the screen:



You try

Make up your own programs using READ DATA to do the following:

1. Rearrange a list

of items.

2. Make a list of months giving the number of days in each month.

Programs using IF/THEN

Spectrum manual 25

IF, THEN are used to introduce alternatives. IF is on key U.
THEN is on key G with symbol shift.

This is what will appear on the screen:

You try

Press **NEW** then **ENTER**. **<>** is on key W with symbol shift. It means 'does not equal'.

Type in the following program.

```
10 PRINT "Type WORD"  
20 INPUT W$  
30 IF W$="WORD" THEN  
  PRINT W$; " is correct"  
40 IF W$ <> "WORD" THEN  
  PRINT W$; " is wrong"
```

Press **RUN** then **ENTER**.

You try

Type WORD then press **ENTER**.

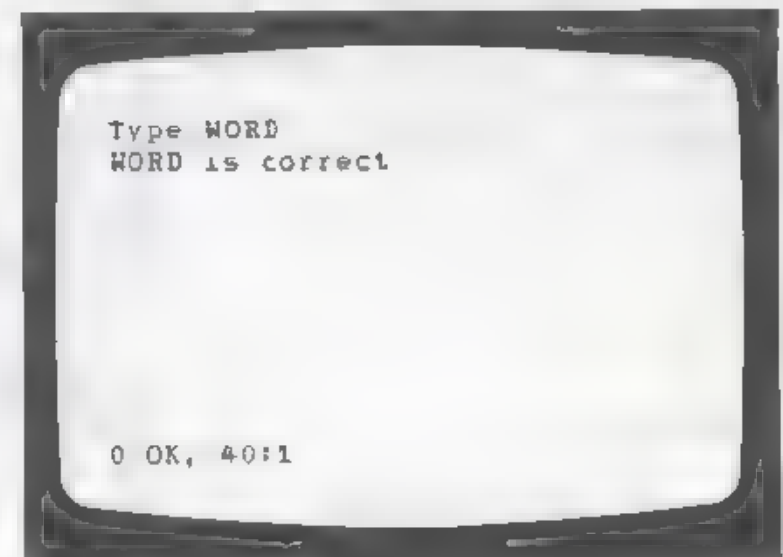
Notice that you must type 'WORD' in capitals for this to work. Run the program again.

You try

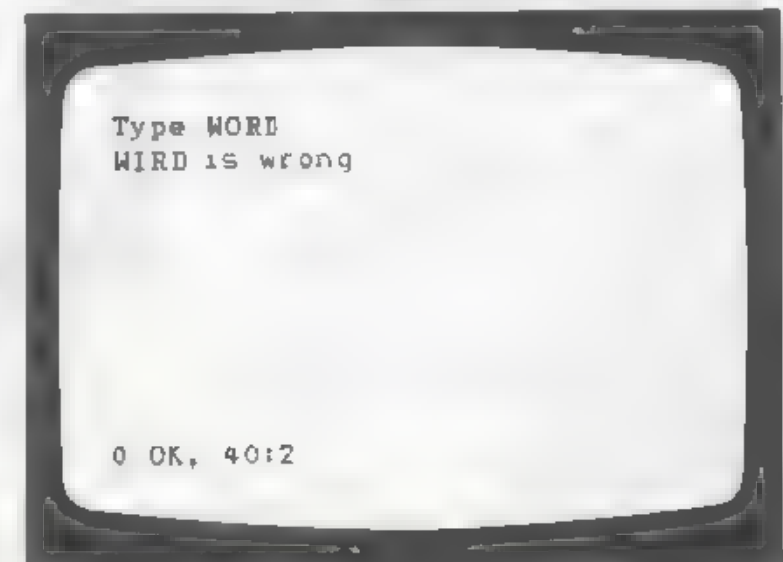
Type WIRD then press **ENTER**.



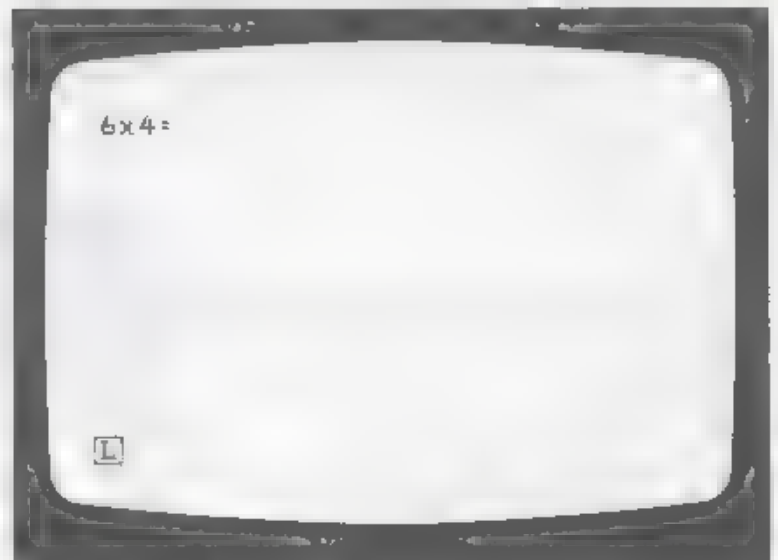
This is what will appear on the screen:



This is what will appear on the screen.



This is what will appear on the screen.



You try

Press **NEW** then **ENTER**.

Type in the following program.

10 **PRINT** "6x4="

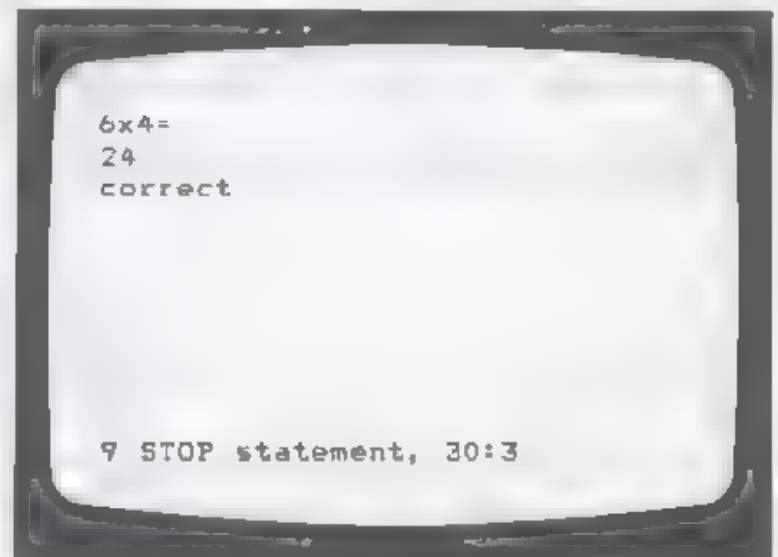
20 **INPUT** ans

30 **IF** ans=24 **THEN** **PRINT** ans'
"correct": **STOP**

40 **PRINT** ans' "wrong"

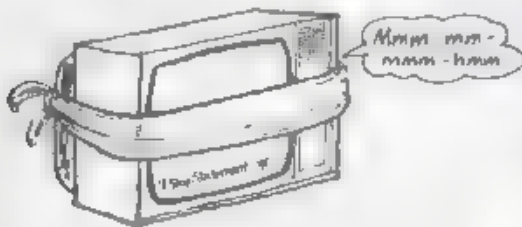
Press **RUN** then **ENTER**.

This is what will appear on the screen:



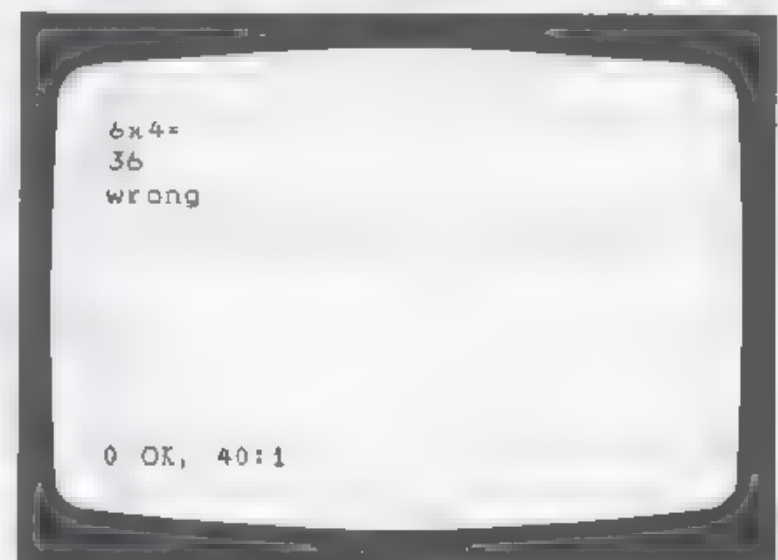
You try

Type 24 then press **ENTER**.



Run the program again.

This is what will appear on the screen:



You try

Type 36 then press **ENTER**.

You try

Make up your own programs using **IF/THEN** to do the following.

1. Check an answer to a simple question.

2. Make the computer ask if you are well and give a suitable reply to your answer.



Programs using GOTO

Spectrum manual 16

GOTO (on key G) is used to jump to a different line in the program.

This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.

Type in the following program.

10 **PRINT** "Type in a number."

20 **INPUT** num

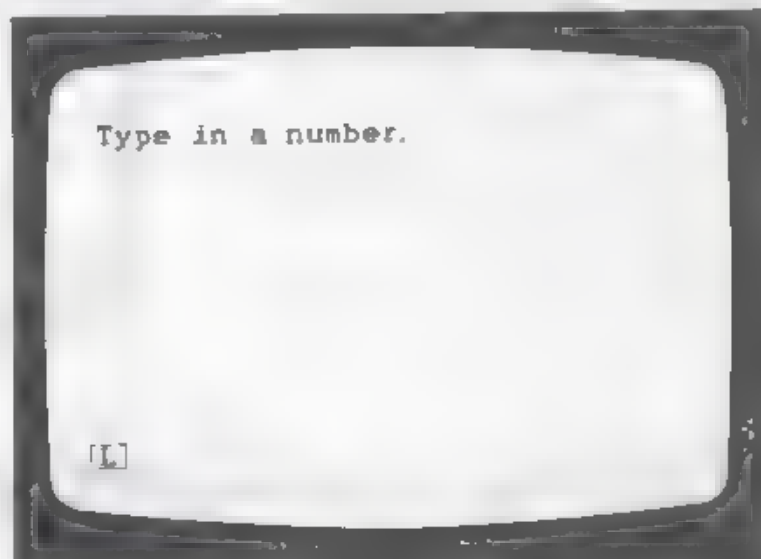
30 **IF** num < 100 **THEN** **GOTO** 60

40 **PRINT** num; "is more than 99."

50 **STOP**

60 **PRINT** num; "is less than 100."

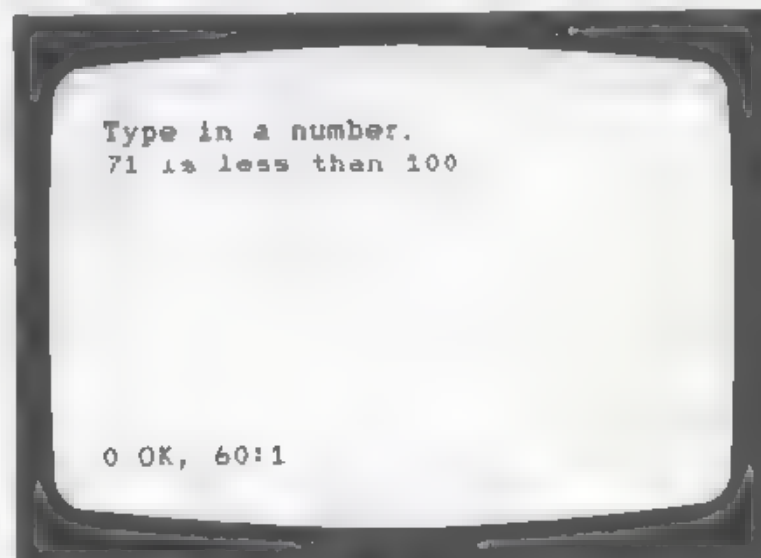
Press **RUN** then **ENTER**.



This is what will appear on the screen:

You try

Type in a number, for example 71, then press **ENTER**.

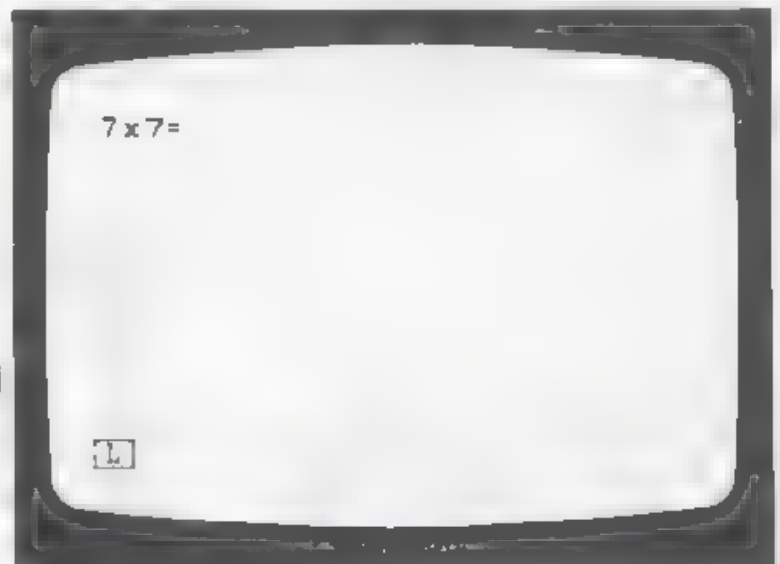


You try

Run the program again and type in a number larger than 100.



This is what will appear on the screen:



You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 PRINT "7x7="
20 INPUT answer
30 IF answer=49 THEN GOTO 60
40 PRINT answer; " wrong"
50 GOTO 10
60 PRINT answer; " correct"
```

Press **RUN** then **ENTER**.

You try

Type in your answer then press

ENTER.

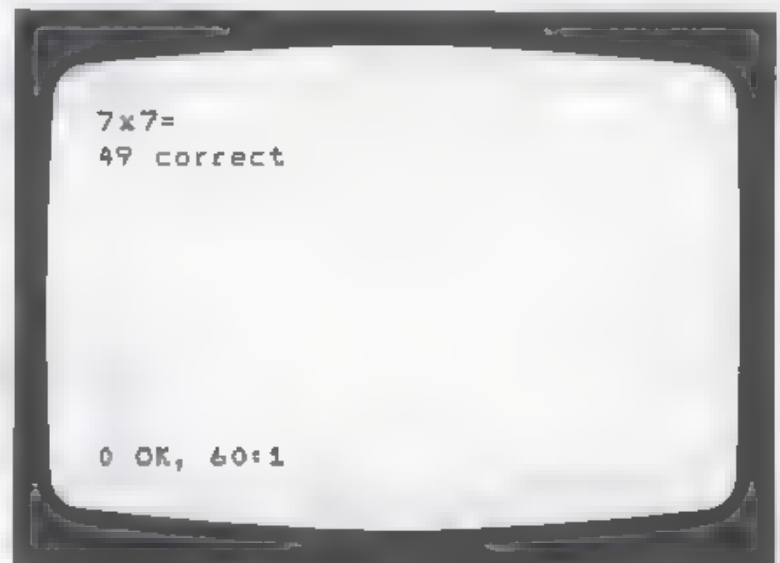


You try

Make up your own programs using GOTO to do the following.

1. Print Yes or No in answer to a question.
2. Print a word in small or in capital letters.
3. Input the cost of five items of shopping and print the total cost. You will need to make the computer keep count of the number of items input so far.

This is what will appear on the screen:

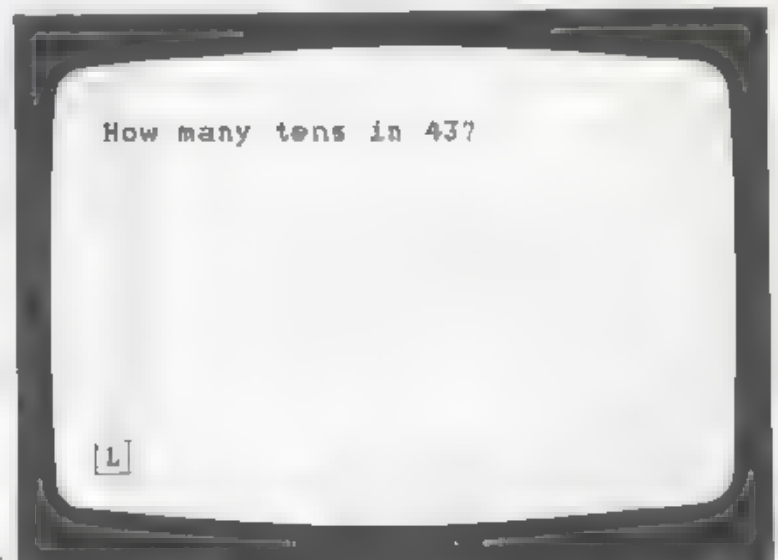


Programs using AND

Spectrum manual 85

AND (on key Y with symbol shift) is used to check two conditions.

This is what will appear on the screen:



You try

Press NEW then ENTER.

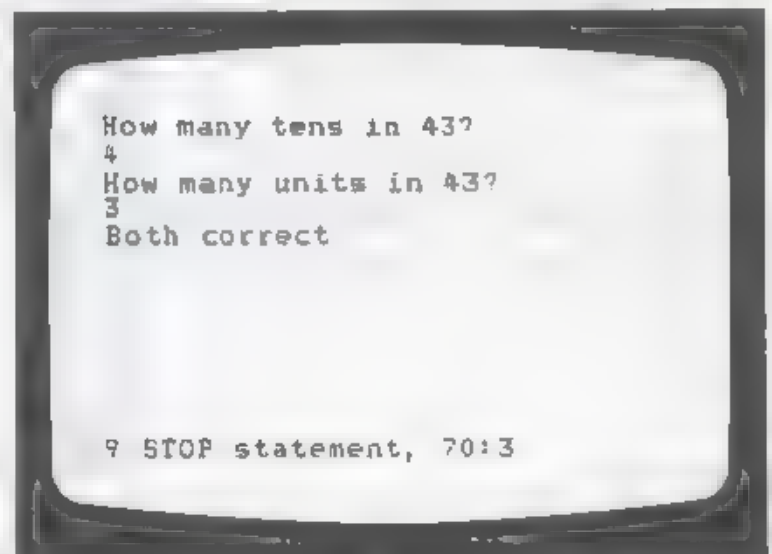
Type in the following program.

```
10 PRINT "How many tens in 43?"
20 INPUT tens
30 PRINT tens
40 PRINT "How many units in 43?"
50 INPUT units
60 PRINT units
70 IF tens=4 AND units=3
 THEN PRINT "Both correct":STOP
80 GOTO 10
```

Press RUN then ENTER.



This is what will appear on the screen:



You try

Type 4 then press ENTER.

Type 3 then press ENTER.

Run the program again.

Type in one or two incorrect answers and notice what happens.

You try

Make up your own programs using AND to do the following:

1. To ask for the first and last letters of the alphabet and to print "well done" if they are both given right.
2. To select two words from a list of words.
3. To select two numbers from a list of numbers.



OR (on key U with symbol shift) is used to check for one of two conditions.

You try

Press [NEW] then [ENTER].

Type in the following program.

```
10 PRINT "Which letter makes an"
```

```
20 PRINT "animal MO.SE"
```

```
30 INPUT I$
```

```
40 PRINT "MO"; I$;"SE"
```

```
50 IF I$="O" OR I$="U"
```

```
THEN PRINT "right"
```

```
60 IF I$<>"O" AND I$<>"U"
```

```
THEN PRINT "wrong"
```

Press [RUN] then [ENTER].

You try

Type O then press [ENTER].

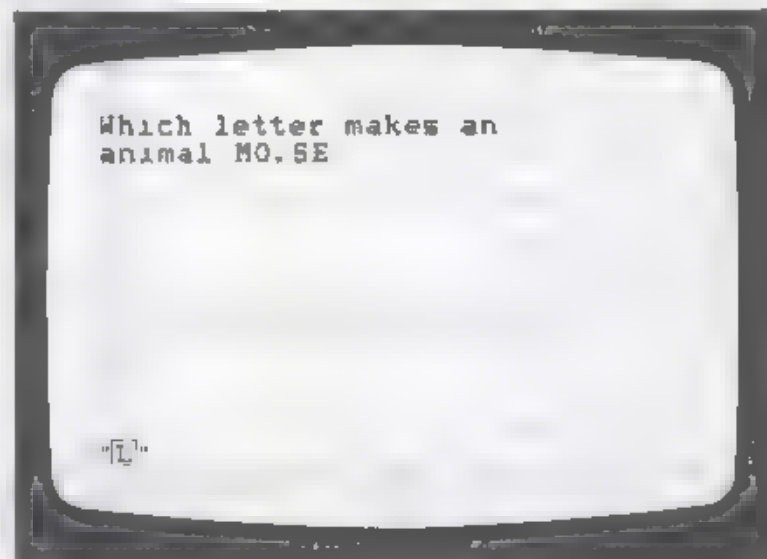
Run the program again and try typing in other letters.

You try

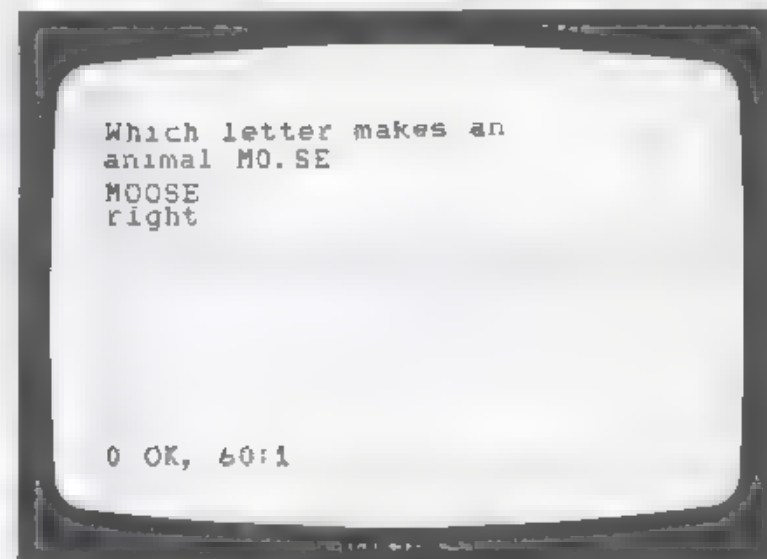
Make up your own programs using OR to do the following.

1. Check for one of two possible answers to a question.
2. Check an answer which may be written in either capital or small letters.
3. Check an answer which may be one of two numbers.

This is what will appear on the screen:



This is what will appear on the screen:



INT (on key R in extended mode) gives the whole number part of a number. For example, INT 2.4 = 2
 RND (on key T in extended mode) chooses a random number between 0 and 1.

You try

Press **NEW** then **ENTER**.
 Type in the following program.
 10 **FOR** n=1 **TO** 20
 20 **PRINT** n/4, **INT** (n/4)
 30 **NEXT** n
 Press **RUN** then **ENTER**.

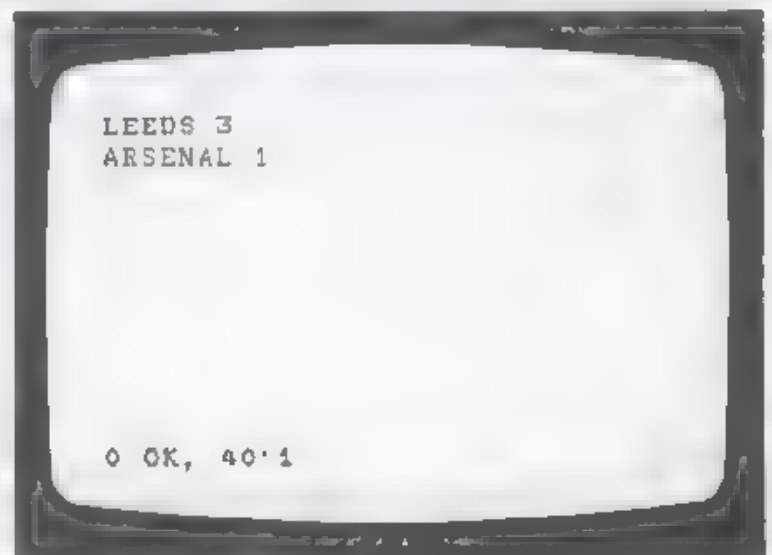


The program above shows how INT works. We need to use INT with RND when we want the answers to be whole numbers. RND chooses a number between 0 and 1 (but not equal to 1), so RND * 4 chooses a number between 0 and 4 (but not equal to 4). INT(RND * 4) chooses one of the numbers 0, 1, 2 or 3.

This is what may appear on the screen:

You try

Press **NEW** then **ENTER**.
 Type in the following program.
 10 **LET** Leeds = **INT** (**RND** * 4)
 20 **LET** Arsenal = **INT** (**RND** * 4)
 30 **PRINT** "LEEDS "; Leeds
 40 **PRINT** "ARSENAL "; Arsenal
 Press **RUN** then **ENTER**.



Since the computer chooses numbers at random it is unlikely that the numbers in this display will be the same as yours.

This is what may appear on the screen:

You try

Press **NEW** then **ENTER**.

Type in the following program.

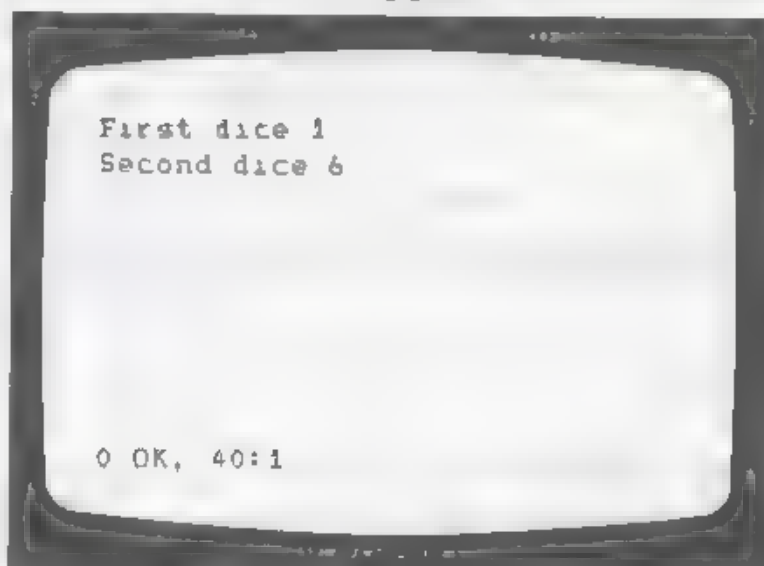
10 **LET** first=1+**INT**(**RND***6)

20 **LET** second=1+**INT**(**RND***6)

30 **PRINT** "First dice ";first

40 **PRINT** "Second dice ";second

Press **RUN** then **ENTER**.



The instruction "**LET** first=1+**INT**(**RND***6)" chooses one of the numbers 1,2,3,4,5,6 at random and puts the chosen number into the address "first". Try running the program several times and different numbers will probably be chosen.

You try

Make up your own programs using **INT** and **RND** to do the following

1. Choose a winning raffle ticket from 1000 tickets.

2. Select numbers for a game of bingo (numbers 1 to 90).

3. Make up sums and print the correct answer when you have had a go.



Programs playing with words

Spectrum manual 51

LEN (on key **K** in extended mode) gives the number of symbols in a word. For example, if x\$="Prof." then **LEN** x\$=5. **LEN** tells us how many spaces a word takes up on the screen.

We can put words together by putting + between them. For example, if x\$="Prof." as before, then x\$+"Crumpet" gives "Prof. Crumpet".

You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 LET b$="HO"
```

20 PRINT b\$

```
30 LET b$=b$+b$
```

```
40 IF LEN b$ < 33 THEN GOTO 20
```

Press **RUN** then **ENTER**.



You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 LET w$="composer"
```

```
20 PRINT W$(1 TO 7)
21
```

30 PRINT W\$(4 TO 8)

40 PRINT W\$(4 TO 7)

```
50 PRINT w$(1 TO 3)+w$(7)
```

Press **[RUN]** then **[ENTER]**.



You try

Try to make as many words as you can if w\$ = "another".



A subroutine is a useful way of repeating some lines of a program. GOSUB is rather like GOTO and is used to jump to the line named after it. RETURN is used to jump back to the instruction after the GOSUB. GOSUB is on key H and RETURN is on key Y.



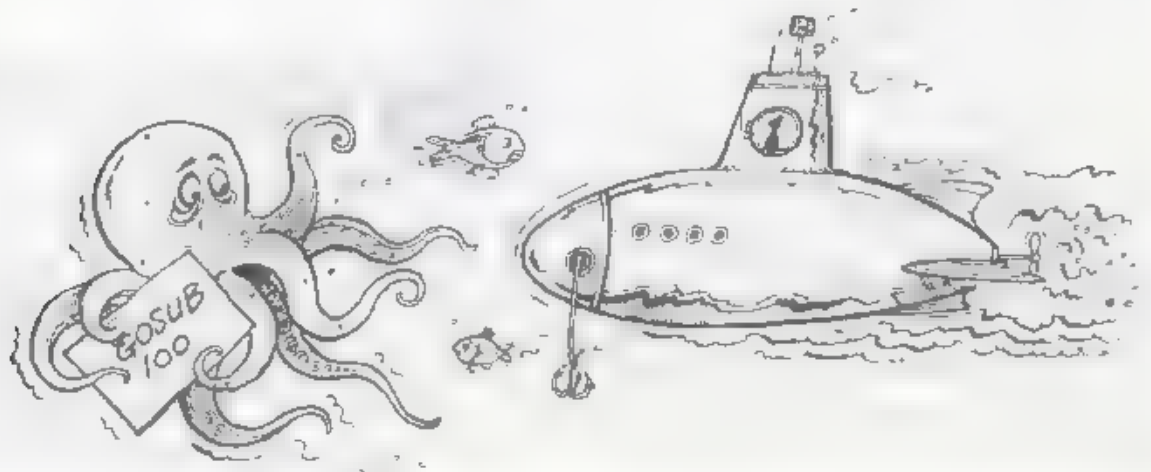
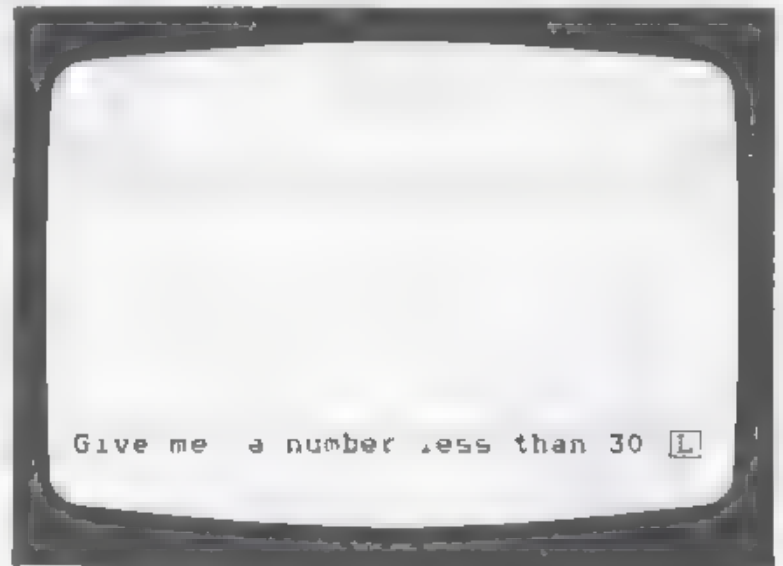
This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.
Type in the following program.
Notice how two instructions can be given on one line if they are separated by a colon. If you prefer you can use the word 'divided' rather than the word 'shared'.

```
10 INPUT "Give me a number less than 30 ";n
20 LET m=2: GOSUB 100
30 LET m=3: GOSUB 100
40 LET m=5: GOSUB 100
50 STOP
100 REM subroutine
110 PRINT "The remainder when ";
120 PRINT n;" is shared" "by ";m;
130 PRINT " is "; n-m*INT (n/m)
140 RETURN
```

Press **RUN** then **ENTER**.



This is what will appear on the screen:

You try

Type in a number, for example 9, then press **[ENTER]**. You may need to add more spaces to make the words look right.

You try

This program can be turned into a game by leaving unchanged lines 20, 30, 40, 100, 110, 130 and 140 and typing in the following lines.

```

10 [LET] n = [INT] (30 + [RND] )
50 [INPUT] "What is my
number?";d
60 [PRINT] "My number is ";n
70 [STOP]
120 [PRINT] "my number is shared
by ";m;

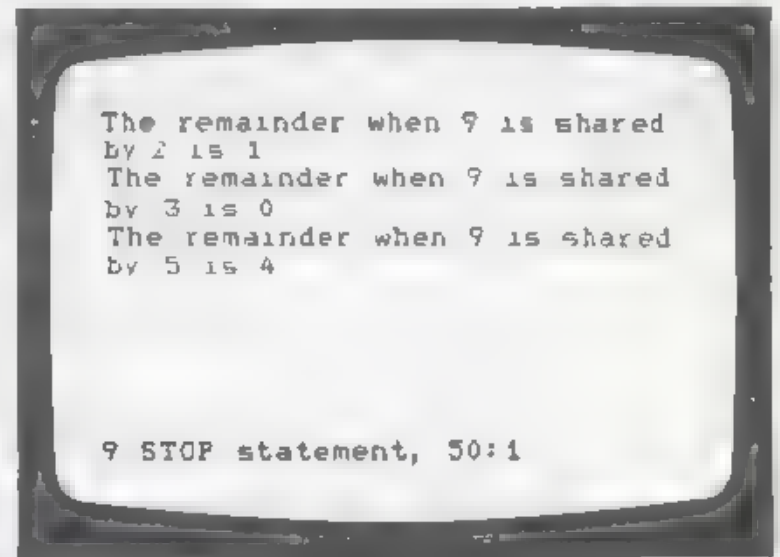
```

Type **[RAND]** (on key T) then **[ENTER]**.

Type **[RLN]** then **[ENTER]**.

Try to guess the number.

You may like to change the program so that it checks whether you have guessed the right number and prints 'right' or 'wrong'.



You try

Press **[NEW]** then **[ENTER]**.

Type in the following program.

```

100 [LET] j$ = "went to mow "
110 [LET] k$ = j$ + "a meadow "
120 [LET] i$ = "one man "
130 [GOSUB] 1000
140 [GOSUB] 2000
150 [PRINT]
160 [LET] i$ = "two men "
170 [GOSUB] 1000
180 [LET] i$ = i$ + ", one man "
190 [GOSUB] 2000
200 [STOP]
1000 [REM] first line subroutine
1010 [PRINT] i$ + j$ + ", " + k$
1020 [PRINT]
1030 [RETURN]
2000 [REM] second line subroutine
2010 [PRINT] i$ + "and his dog " + k$
2020 [PRINT]
2030 [RETURN]

```

Press **[RUN]** then **[ENTER]**.

Add a few lines to the program so that it will print out a third verse as well.



Project 1 – KNOCK, KNOCK

The aim of this program is to make the computer tell knock, knock jokes. First it is necessary to set up some starting values and give some data. The main steps are given below.

1. LET count = 0 (We are going to count the number of jokes so that we know when we have reached the end. This is to start the count. We shall increase the count by one each time a joke is told.)

LET jokes = 6 (This gives the number of jokes the computer can tell.)

The data for this program can be entered as DATA "Ivor", "sore hand from knocking on your door", "Howard", "I know", "Mr", "last bus home", "Amos", "quito", "Lettuce", "in and you'll find out", "Ken", "I come in".

2. Now we can set up the main part of the program. The computer should be made to

(a) ask if you want to hear a knock, knock joke;

(b) INPUT the answer;

(c) if the answer is 'no' then STOP;

(d) READ n\$,l\$ (name and last line);

(e) PRINT "Knock, knock"

"Who's there?"

n\$

n\$ + " who?"

n\$,l\$

(This will take several PRINT statements.)

(f) LET count = count + 1 (increasing count by one);

(g) IF count < 6 THEN go to part (a) (so that the next joke is told).



Improvements and variations

A. Add some more jokes.

B. Make the telling of the jokes into a conversation with the computer. Then the computer will PRINT "Knock, knock", you will INPUT "Who's there?", etc.

C. Make the program STOP if the answer to 'Do you want to hear another joke?' is 'no' or 'NO' or 'No'.

D. Make the computer PRINT a message when it has run out of jokes to tell.

E. Include a pause between telling one joke and asking if you wish to hear another. This can be done by inserting the line PAUSE 200 (PAUSE is on key M). A larger number after PAUSE will make the pause longer.



Project 2 – Countdown

In this project you will program the computer to play a game with you. In the game you start with 20 counters. You and the computer take it in turns to remove 1, 2, 3 or 4 counters. The one to remove the last counters so that none are left is the winner. The program can be written as follows.

1. Make the computer explain the game using PRINT.
2. Set up the numbers of counters to be 20.
3. Have your turn which consists of the following steps.
 - (a) Make the computer ask for the number of counters you wish to remove and INPUT the answer.
 - (b) Take away your answer from the number of counters to give the number of counters remaining and PRINT the result.
 - (c) Check whether the number of counters is zero. If it is then make the computer tell you that you have won and STOP the game.
4. Make the computer have a turn by doing the following steps.
 - (a) If the number of counters is less than five (<5), then the computer can choose to remove all the counters. If the number of counters is greater than or equal to 5 (≥ 5) then the computer chooses to remove a random number of counters between 1 and 4 (use $1 + \text{INT}(\text{RND} * 4)$). (Use IF/THEN twice for this part.)
 - (b) Calculate the new number of counters and PRINT the result.
 - (c) Check whether the number of counters is zero. If it is then the computer says that it has won and STOPs the game, otherwise it returns to your turn (step 3). Make sure that the name for the number of counters is the same as at the beginning of step 3.

Improvements and variations

A. The computer could ask whether you want the first turn, and if not have the first turn itself.

B. Instead of having the computer write down the number of counters, make it draw the counters (use PRINT and the letter O as a counter).

C. Make the screen clearer by using CLS, PRINT on its own for a blank line, and extra spaces.



D. It would be a good idea to make the computer check that you are not cheating by trying to remove too many counters or none at all.

E. You could vary the number of counters at the start and the number which may be picked up at each turn.

F. When you have played the game a few times and know how to beat the computer, try making the computer play more intelligently.



Project 3 – Lions and antelopes

The purpose of this program is to set up a situation like the one faced by the warden of a game park in Africa. We shall look at the lions and antelopes in the game park. The lions kill the antelopes for food (about 200 each in a year), and the warden has to choose how many lions to kill to keep the numbers under control.

The structure of the program is as follows.

1. Make the computer explain the situation for someone new coming to the program, using PRINT.

2. Give starting values for the number of lions and the number of antelopes. It is sensible to start with about 15 lions and 10000 antelopes.

3. Make the computer ask for the number of lions to be killed this year and INPUT the reply. This number is called the cull.

4. Work out the number of lions and antelopes for the following year using the equations below.

LET lions=INT(lions cull +
lions*(antelopes 400*lions)/10000)

LET antelopes=INT(antelopes 200*lions +
antelopes*(20000 antelopes)/30000)

INT makes sure that the answer is a whole number. The equation for the lions says that the new number of lions is the number from the previous year, minus the number killed, plus a number of births and deaths depending on the number of lions available to breed and the number of antelopes available as food. The equation for the antelopes is the number from the previous year, minus the number killed by lions, plus the number of births and deaths. Make the computer PRINT the new number of lions and antelopes.

5. Make the computer ask if you want another go, and if so then go to step 3.

Improvements and variations



- A.** Alter the number of lions and antelopes at the start either by using INPUT so that the user chooses them, or by using RND so that the computer chooses them.
- B.** Make the computer keep a count of the year and PRINT the year number each time round. The computer could then ask if you wish to continue after every ten years, instead of every year.
- C.** Include a check that the number of lions and the number of antelopes do not become negative
- D.** Include messages of congratulations if the number of lions and antelopes become large and scold the user if they become small.
- E.** Make the writing on the screen clearer by using CLS (to clear the screen), PRINT on its own (to give a blank line), and put in extra spaces between words so that no words are split between lines.
- F.** If you feel ambitious you could try drawing a picture of the park, and using symbols for lions and antelopes (say one symbol to represent a lion and another to represent 100 antelopes). You will be able to do this better after reading the next chapter.

Other ideas for computer programs

1. A game of chance which uses random (RND) numbers
2. A spelling test
3. A list of questions on a particular subject
4. A musical scale
5. A questionnaire
6. A coloured diagram
7. A science experiment
8. A clock
9. A cash register
10. An anagram finder
11. A language translator
12. A passage in which missing words have to be filled in
13. A pattern designer
14. A list of names and addresses
15. A plan or scale drawing
16. A word game
17. An alphabetical sorter
18. A number game with questions and answers
19. A foreign money exchange
20. A cartoon
21. A maze
22. A rocket launcher
23. A TV advert
24. A guessing game
25. A tune

You may need to look back at some of the programs in the book or ones which you have written yourself.

It may also be helpful to check certain things in the reference sections from time to time. Some of the programs you will find easier after you have looked at the next chapter.

SPECIAL FEATURES



Mort Puce

My advice

My advice is to look at new commands carefully. When you think you understand the idea, experiment and try things out. You will learn what looks right. Of course, when you work like this you may create a mess. Don't be put off: try again. Remember your successes and forget about your failures.

Try out all the ideas you can think of. Explore lines, angles, shapes, colours and even music. You can draw almost anything on the screen and colour it in different ways and then to celebrate your masterpiece compose a tune.

When you hit on a good idea make sure you write some notes about it, so that you will be able to use the idea again.

Mortimer Puce



Drawing on the screen

DRAW (on key W) is used to draw lines and shapes. To draw a straight line DRAW must be followed by two numbers separated by a comma. For example,

DRAW 100,150

DRAW -20,30

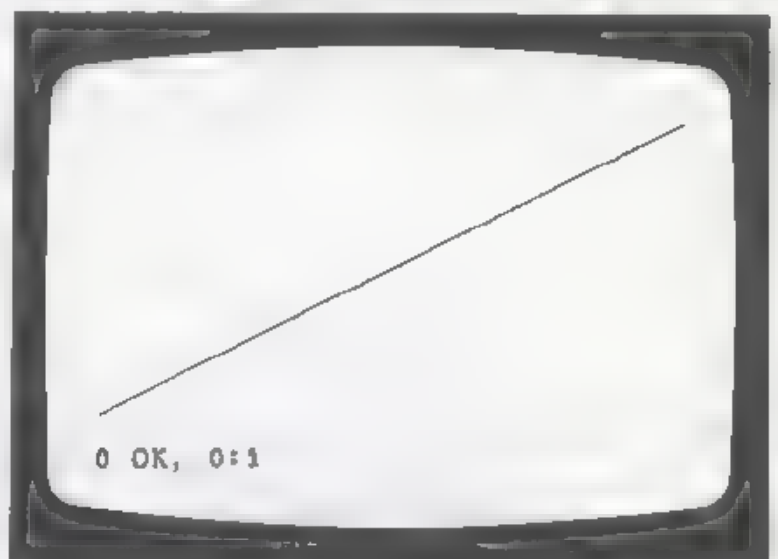
DRAW operates in a similar way to drawing on a piece of paper, without lifting the pencil. The first number after DRAW gives the distance across, and the second number gives the distance up the screen that the line travels. Minus numbers make the line go left and down.

This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.

Type **DRAW 255,175**
then press **ENTER**.



This is what will appear on the screen:

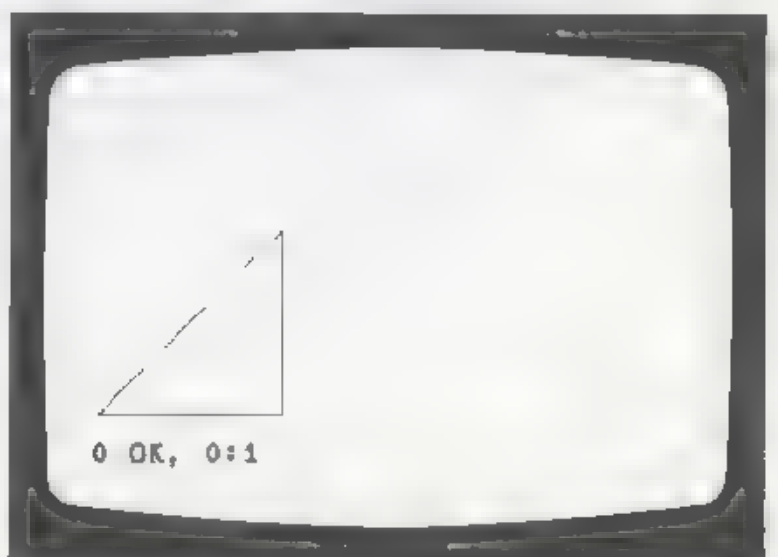
You try

Press **NEW** then **ENTER**.

Type **DRAW 100,0**
then press **ENTER**.

Type **DRAW 0,100**
then press **ENTER**.

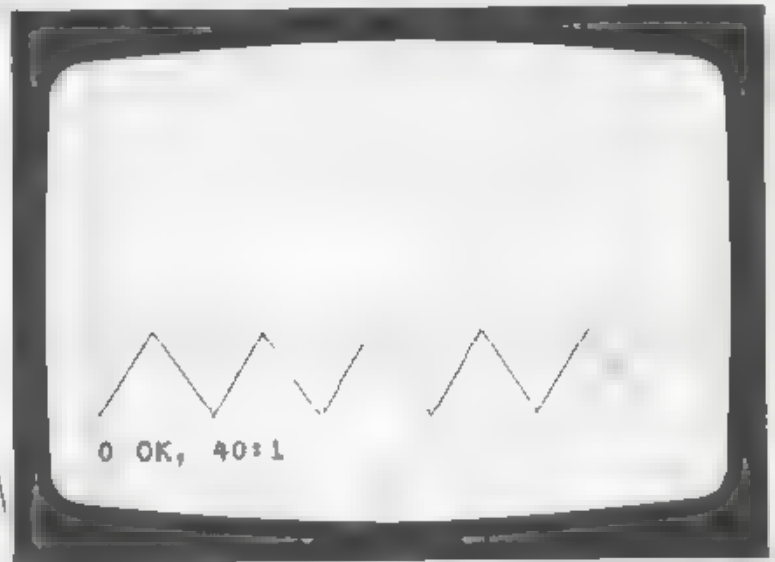
Type **DRAW -100,-100**
then press **ENTER**.



This is what will appear on the screen:

You try

Press **NEW** then **ENTER**.
Type in the following program.
10 **FOR** n=1 **TO** 5
20 **DRAW** 25,25
30 **DRAW** 25,-25
40 **NEXT** n
Press **RUN** then **ENTER**.



Make a note

DRAW is on key W.
DRAW must be followed by two numbers separated by a comma.
The first number must be between -255 and 255. The second number must be between -175 and 175.



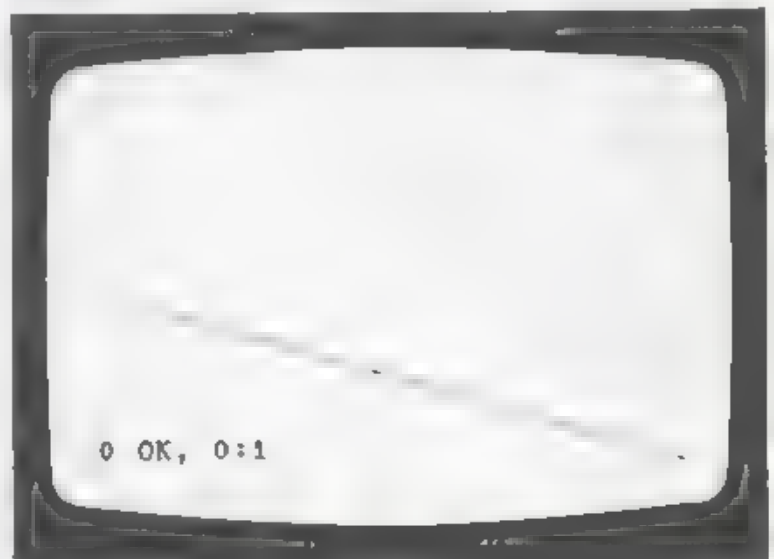
Plotting on the screen

PLOT (on key Q) is used to move on the screen without drawing a line and also to make a small dot. When using **DRAW** you will find sometimes that you need to move to another point on the screen without drawing a line. This can be done using **PLOT**. **PLOT** must be followed by two numbers separated by a comma. The first number gives the distance across, and the second number gives the distance up the screen that a dot is placed. Any line using **DRAW** will be drawn from this dot.

This is what will appear on the screen:

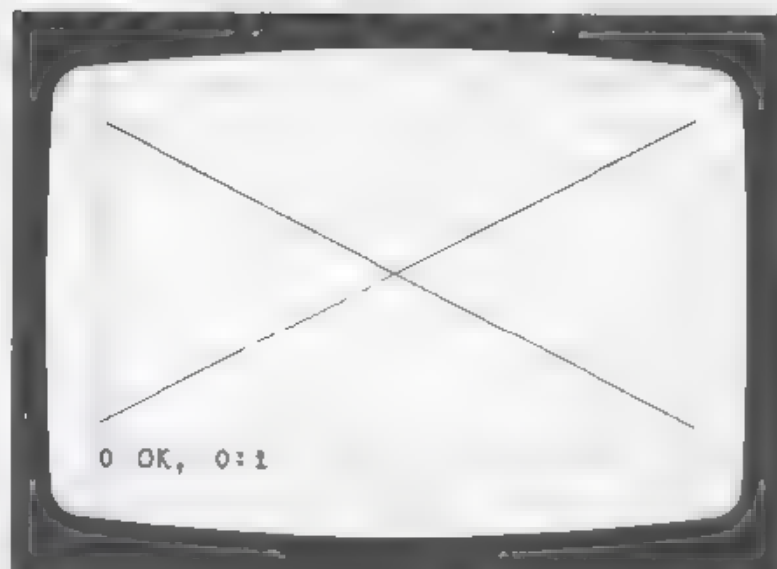
You try

Press **NEW** then **ENTER**.
Type **PLOT** 0,100
then press **ENTER**.
Type **DRAW** 255,-100
then press **ENTER**.



You try

Press **NEW** then **ENTER**.
Type **DRAW** 255,175
then press **ENTER**.
Type **PLOT** 255,0
then press **ENTER**.
Type **DRAW** -255,175
then press **ENTER**.



The next 'You try' shows how **PLOT** can be used to draw some pretty curves called Lissajous' curves. The program uses **PI** (on key **M** in extended mode) and **SIN** (on key **Q** in extended mode). You can use the program even if you do not know about **PI** and **SIN**.

You try

Press **NEW** then **ENTER**.
Type in the following program.

```
10 LET n=500
20 LET a=5: LET b=7
30 LET p=6
40 LET p=p*PI 12
50 FOR t=0 TO n
60 GOSUB 100
70 PLOT x,y
80 NEXT t
90 STOP
100 LET s=2*PI*t/n
110 LET x=SIN(a*s+p)
120 LET y=SIN(b*s)
130 LET x=100*x+128
140 LET y=80*y+88
150 RETURN
```

Press **RJN** then **ENTER**.

You try

Change line 20 to

20 **LET** a=1: **LET** b=1

and run the program again.

Put other values for **a** and **b** in line 20 and see what other curves you can make. You can also try changing the value of **p** in line 30.

The value of **n** in line 10 gives the number of dots. If you make **n** bigger, the dots will be closer together and the curve will take longer to draw.

Make a note

PLOT is on key **Q**.
PLOT must be followed by two numbers separated by a comma.
The first number must be between 0 and 255.
The second number must be between 0 and 175.



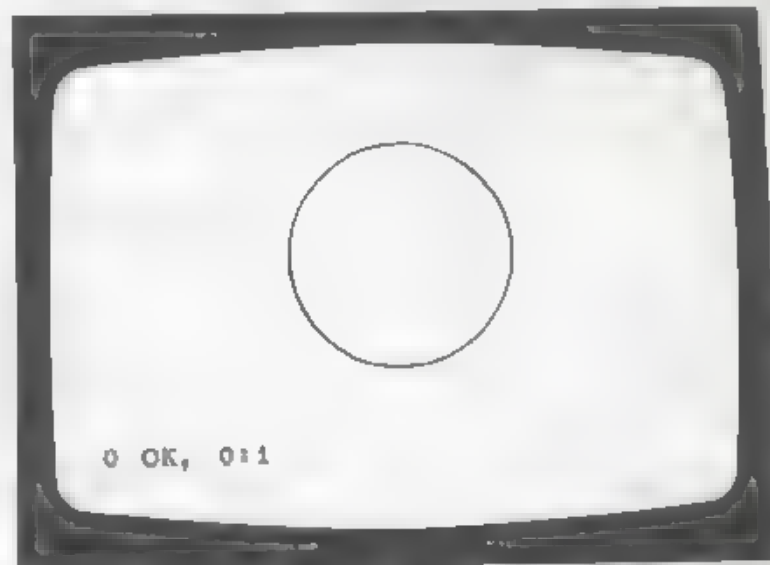
CIRCLES ON THE SCREEN

CIRCLE (on key H in extended mode with symbol shift) draws a circle. It is followed by three numbers. The first two give the position of the centre (the first number is the distance across and the second is the distance up the screen), and the third number gives the radius.

This is what will appear on the screen.

You try

Press **NEW** then **ENTER**.
Type **CIRCLE 125,85,50**
then press **ENTER**.



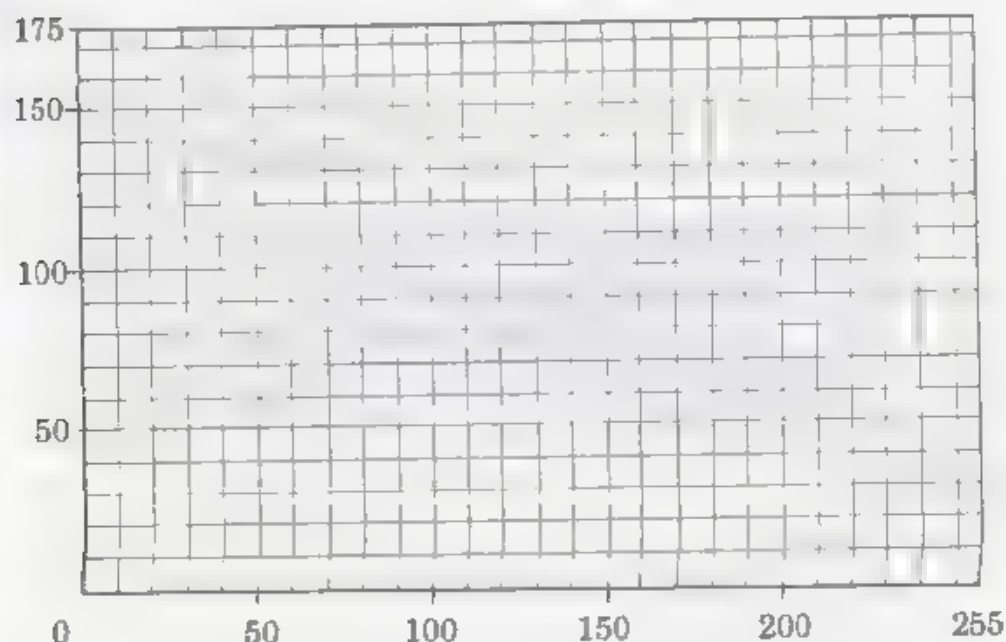
You try

Press **NEW** then **ENTER**.
Type in the following program.
10 **FOR** r=10 **TO** 80 **STEP** 10
20 **CIRCLE** 125,85,r
30 **NEXT** r
Press **RUN** then **ENTER**.

You try

Use **DRAW**, **PLOT** and **CIRCLE** to draw a house or a person.

To help you plan your drawings, here is a grid giving distances across and up the screen.





Changing colours

The colour of characters is given by INK (on key X in extended mode with symbol shift), the background colour is given by PAPER (on key C in extended mode with symbol shift) and the colour of the edge of the screen or border is given by BORDER (on key B). The colours with their codes are

- 0 black,
- 1 blue,
- 2 red,
- 3 purple (called magenta on the computer),
- 4 green,
- 5 pale blue (called cyan),
- 6 yellow,
- 7 white.

You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 BORDER 3
20 INK 6
30 PAPER 2
40 PRINT "Yellow on red"
50 CIRCLE 200,100,40
```

Press **RUN** then **ENTER**.

You try

Add the line

```
35 CLS
```

to the last program and see what happens.

INK and PAPER can be used inside PRINT statements so that they apply just to that line.

You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 BORDER 1
20 PRINT INK 2; PAPER 6; "Red
on yellow"
30 PRINT INK 5; PAPER 0;
"Cyan on black"
```

```
40 PRINT INK 7; PAPER 3;
"White on magenta"
```

```
50 PRINT INK 1; PAPER 4; "Blue
on green"
```

Press **RUN** then **ENTER**.

WARNING! If your INK colour and PAPER colour are the same, you will not be able to read what is on the screen.

BRIGHT (on key B in extended mode with symbol shift) is used to make colours brighter. **BRIGHT 1** turns the brightness on and **BRIGHT 0** turns it off again. **BRIGHT** can be put after **PRINT** so that it applies just to that line.

You try

Press **NEW** then **ENTER**.
Type in the following program.

```
10 BORDER 0
20 FOR c=1 TO 7
30 PAPER c
40 PRINT "normal",
50 PRINT BRIGHT 1; "bright",
60 PRINT PAPER 0,,
70 NEXT c
80 PRINT "These are the colours."
```

Press **RUN** then **ENTER**.



FLASH on (key V in extended mode with symbol shift) is used to make characters flash. **FLASH 1** turns the flashing on and **FLASH 0** turns it off again. **FLASH** can also be used with **PRINT**.

You try

Press **NEW** then **ENTER**.
Type in the following program.

```
10 PAPER 4: INK 6: BRIGHT 1
20 PRINT "Here is a ";
30 PRINT FLASH 1; "flash"
40 PRINT "which makes words ";
50 PRINT FLASH 1; "stand out"
```

Press **RUN** then **ENTER**.

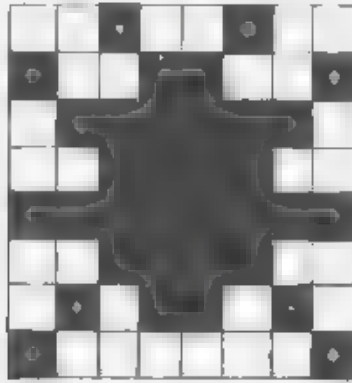
*PAPER and INK and FLASH and BRIGHT
mean painting's done at the speed of light*





User-defined graphics

In the keyboard section you learnt about the graphics characters on the number keys. You are now going to learn how to design your own characters. First you need to make up your design on a grid which is 8 squares by 8 squares. For example, here is a beetle.



We shall tell the computer about our design a row at a time, using 0 for a white square and 1 for a black square. BIN (on key B in extended mode) is used to tell the computer that the number is in binary, which means that it just uses 0 and 1. The next 'You try' also uses the commands POKE (on key O) and USR (on key L in extended mode). POKE is used to put each row into a special place in the computer's memory. USR is used to say that the letter following USR is the special place.

You try

Press **NEW** then **ENTER**.

Type in the following program.

```
10 DATA BIN 00100100
20 DATA BIN 10011001
30 DATA BIN 01111110
40 DATA BIN 00111100
50 DATA BIN 11111111
60 DATA BIN 00111100
70 DATA BIN 01011010
80 DATA BIN 10000001
```

```
100 FOR n=0 TO 7
```

```
110 READ row
```

```
120 POKE USR "b"+n,row
```

```
130 NEXT n
```

Press **RUN** then **ENTER**.

Nothing exciting will appear on the screen yet.

Now go into graphics mode (hold down **CAPS SHIFT** and press 9) and then type B.

You try

Design your own graphics character on a grid. Change the first eight lines of the last program to give the new rows.

Change line 120 to

120 POKE USR "a"+n,row

Run your new program.

Go into graphics mode and type A to see your character.



It is useful to be able to tell the computer where to print a character. To do this use AT (on key I with symbol shift) after PRINT and follow it by two numbers to give the row and column. For example, PRINT AT 10,20; "X" will print a cross in the 10th row and 20th column.

You try

Press NEW then ENTER.

Type in the following program which is a first attempt to make the beetle walk up the screen.

10 FOR r=21 TO 0 STEP -1

20 PRINT AT r,10; "❖"

30 NEXT r

Press RUN then ENTER.



NEW rubs out the old program, but leaves the user defined graphics unharmed.

❖ is produced by going into graphics mode and typing B. Remember to come out of graphics mode afterwards. This program leaves a line of beetles. To make it look as if one beetle is walking up the screen, another program line is needed which puts a space in the row $r+1$ and wipes away the beetle there.

You try

Add this line to the last program.

```
25 IF r<21 THEN PRINT AT  
r+1,10;" "
```

Now run the program again.



The beetle may be going too fast for you so you could add the line

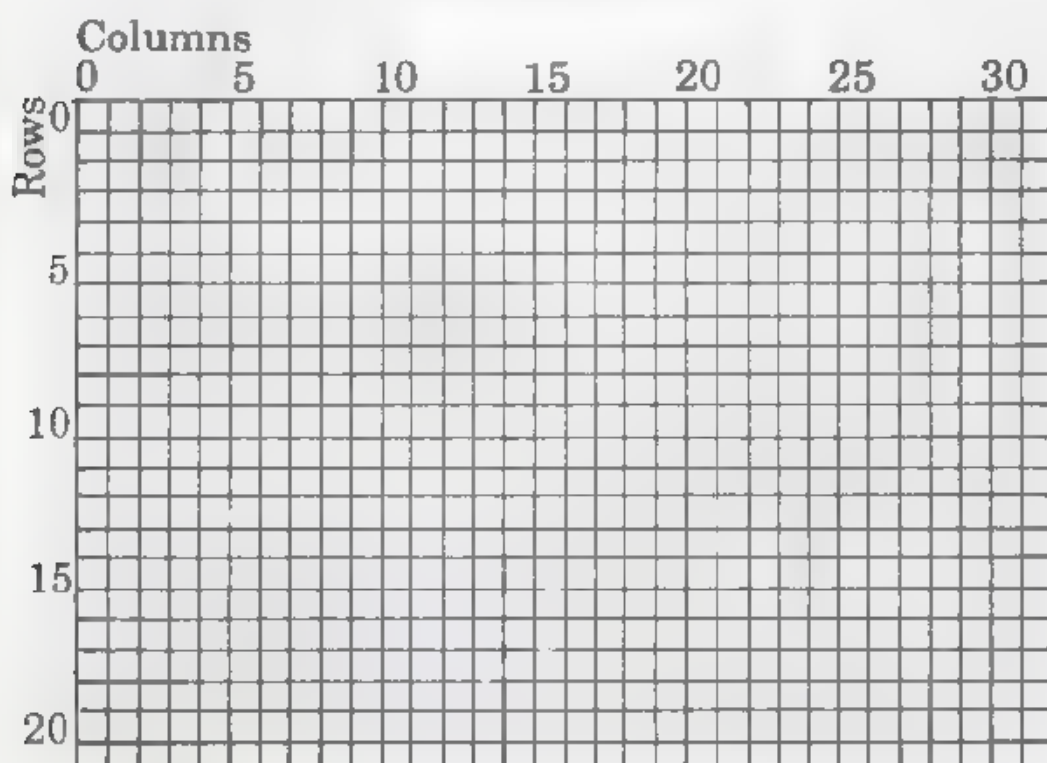
```
27 PAUSE 5
```

Make the beetle go faster or slower by making the number after PAUSE smaller or bigger.

You try

Design your own creature and make it move around the screen. Also try adding colour. To help you plan moving your creature, a grid showing rows and columns is given below.

*Graphics are fun
When the Beetles run*



Making music

BEEP (on key Z in extended mode with symbol shift) is used to play musical notes. BEEP is followed by two numbers separated by a comma. The first number gives the number of seconds the note is played. The second number selects how high or low the note is (called the pitch).

You try

Type `BEEP 2,0`

This plays a long low note.

You try

Type `BEEP .5,20`

This plays a short, high note.



The next 'You try' shows how high the notes can go. See if you can hear them all.

You try

Use BEEP to play some notes of your own.

You try

Type in the following program.

10 `FOR` n=0 `TO` 69

20 `BEEP` .5,n

30 `NEXT` n

Press `RUN` then `ENTER`.

You try

Change the last 'You try' by adding '`STEP .1`' to the end of line 10 and changing the length of the note from .5 to .01 in line 20. Now run the program again.

Try making your own changes to the program



You try

Use BEEP to compose a short tune.

Make a note

BEEP must be followed by two numbers separated by a comma. The first number gives the length of the note. The second number gives the pitch.



Project 4 - Patterns

In this project we shall use a simple program to make some patterns on the screen. The program will become more complicated as we go on. Type in the following lines:

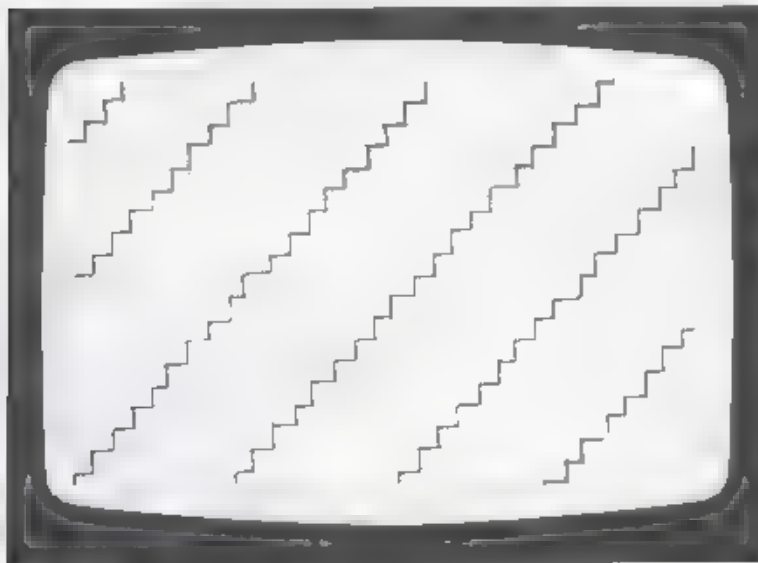
```
100 FOR y=0 TO 20
110 FOR x=0 TO 30
200 PRINT AT y,x; PAPER p; " ";
250 NEXT x
260 NEXT y
```

The gaps in the numbering are for extra lines we shall add. Perhaps you can see how this program works: x counts across the page, y down the page, and line 200 prints at the point y,x a space in the colour p. Of course, by itself this program will not work as we have not told the computer what p is. Add the line:

```
120 LET p=(x+y)/8
```

and RUN the program.

You will have stripes of colour going across the screen:



Try it again with:

```
120 LET p=(x-y+20)/7
```

instead. You may like to try it with your own expressions for p in line 120. Invent a few. If you do you may get error messages like:

B Integer out of range, 200:1

or K Invalid colour, 200:1

This is because the number p sometimes becomes either less than 0 or more than 9. For example, this happens if you try

```
120 LET p=x+y
```

It is a nuisance to have to design an expression for p carefully so that it always gives an answer between 0 and 9. Instead we can make p any expression, and then replace it if it is too large or too small.



A. One way to do this is to add the line:

```
130 [LET] p=p-7* [INT] (p/7)
```

The useful expression $p-7* [INT] (p/7)$ gives the remainder when p is divided by 7. Try this with:

```
120 [LET] p=x+y
```

 and other expressions in line 120 such as:
 $x*x$, $x*y$, $x-y$, $x*x+y*y$, $7*y/(x+1)$.

Try some expressions of your own. Make a note of any you particularly like so that you can use them later.

B. One way to change the program is to use a graphics character in place of the space in line 200. For example, try EDITing 200 to:

```
200 [PRINT] [AT] y,x; [PAPER] p; "■";
```

using the graphics character on key 6. Try this with one of the expressions such as:

```
120 [LET] p=(x+y)/5
```

Try it with other graphics characters and other expressions.

You can try adding $INK\ q$ to line 200 and giving an expression for q in line 140 and adding the line:

```
150 [LET] q=q-7* [INT] (q/7)
```

C. Going back to having the original line 200, a complicated expression to try in line 120 is:

```
120 [LET] p=((y-10)*(y-10)+(x-15)*(x-15))/20
```

Try EDITing this line to be

```
120 [LET] p=((y-10)*(y-10)/4+(x-15)*(x-15)/5)/20
```

and see what happens. Try changing the numbers 4, 5 and 20.

Another expression to try is:

```
120 [LET] p=(x-15)*(y-10)/10
```

or similar expressions but with numbers other than 10 at the end.



D. You may like to make the colours come in a different order, such as:

black, red, magenta, blue, cyan, green, yellow, white.

To do this change line 200 to be:

```
200 [PRINT] [AT] y,x; [PAPER] a(p); " ";
```

Now we must tell the computer what values $a(p)$ has. It will have one for each possible p , where p will be 1,2,3,4,5,6,7 or 8.

Do this by adding the lines:

```
20 [FOR] i=1 [TO] 8
```

```
30 [READ] a(i)
```

```
40 [NEXT] i
```

```
50 [DATA] 0,2,3,1,5,4,6,7
```

The numbers in line 50 correspond to the order of the colours. We need to warn the computer how many of a(i) there will be so we must add the line:

```
10 DIM a(8)
```

to show that there will be eight of them.

The computer likes to start at a(1) rather than at a(0) so line 200 must be changed to:

```
200 PRINT AT y,x; PAPER a(p+1); " ";
```

Now RUN the program with different expressions in line 120. The values for a(i) you have been using make up an array. You can read more about arrays in Chapter 12 of the Spectrum manual.



Project 5 – Making pictures

This project will provide you with subroutines which you can use to build up pictures of your own.

The first subroutine can be used to give the background colour of the bottom part of the screen from a certain row (called w) downwards. Before using the subroutine you need to give the colour using PAPER (and BRIGHT if you wish), and to give the value of w using LET.

```
500 FOR i=w TO 21
510 FOR j=0 TO 31
520 PRINT AT i,j;" ";
530 NEXT j
540 NEXT i
550 RETURN
```

The second subroutine will draw a disc with centre distance x across the screen and distance y up the screen, and radius r. Before using the subroutine you need to give the colour using INK (and BRIGHT if you wish) and to give the values of x, y and r using LET.

```
600 FOR k=1 TO r
610 CIRCLE x,y,k
620 NEXT k
630 RETURN
```

The third subroutine will draw a rectangle which goes a distance b across the screen and a distance h up the screen. Before using the subroutine you need to give the colour using INK (and BRIGHT if you wish), to use PLOT to make a dot where you want the bottom left-hand corner to be, and to give the values of b and h using LET.

```
700 DRAW b,0
```

```

710 [FOR] m=1 [TO] h
720 [DRAW] -b,1
730 [DRAW] b,0
740 [NEXT] m
750 [RETURN]

```

Here is a sample program to show you how these subroutines can be put together. First let us make the border black and the main background colour blue by:

```

10 [BORDER] 0
20 [PAPER] 1: [CLS]

```

We make the screen bright green from row 16 downwards by

```

30 [PAPER] 4: [BRIGHT] 1
40 [LET] w=16: [GOSUB] 500

```

We make a bright yellow sun in the sky by

```

50 [INK] 6
60 [LET] x=200: [LET] y=130: [LET] r=20
70 [GOSUB] 600

```

Now we draw a red car. Notice how the brightness is turned off by BRIGHT 0, and that we do not need to give y and r a second time if they are staying unchanged.

```

80 [INK] 2: [BRIGHT] 0
90 [LET] b=50: [LET] h=10
100 [PLOT] 100,55: [GOSUB] 700
110 [LET] b=30: [LET] h=15
120 [PLOT] 102,65: [GOSUB] 700
130 [LET] x=110: [LET] y=50: [LET] r=8
140 [GOSUB] 600
150 [LET] x=140
160 [GOSUB] 600

```

Now that we have finished we must add the line

```

170 [STOP]

```



Make sure that you have all the subroutines typed in as well and then RUN the program. Try using the second and third subroutines to make a tree to add to the left-hand side of the picture.

Now you can make pictures of your own with the subroutines, using the grid on page 76 to help you plan. You can add your own user-defined graphics if you wish.

Project 6 - Music

The object of this program is to play the tune Brother Joseph (Frère Jacques). The English words, with notes above, are given below.

G A B G G A B G

Brother Joseph, Brother Joseph,

B C' D' B C' D'

Wake up now! Wake up now!

D' E' D' C' B G D' E' D' C' B G

Go and pull the bell rope. Go and pull the bell rope.

G D G G D G

Ding, dang, dong. Ding, dang, dong.

Each note can be given to the computer as a command of the form BEEP time, pitch. Time gives the length of the note and pitch says how high or low it is. The numbers for the pitch are

D	E	F	G	A	B	C'	D'	E'
2	4	5	7	9	11	12	14	16

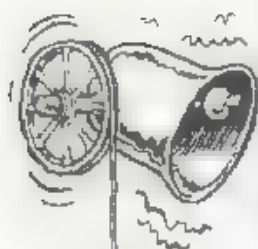
The time should be .5 for the short notes, 1 for the medium length notes, and 2 for the long notes. If you find it difficult to decide on the timing, put the time to be 1 for all the notes at first, and make changes after listening.

Some suggestions for writing this program are given below. You may find them useful.

A. LET $t = 1$ at the beginning of the program and then let the time be given as $t/2$, t or $2*t$ as appropriate (rather than .5, 1 or 2) Then the speed at which the tune is played can be changed easily, by changing the value of t . The value of t gives the length of a beat.

B. It is a good idea to use DATA/READ in a similar way to the Knock, knock project. This is a better way to program and needs less typing. It also makes it easier to change the key in which the tune is played, that is to play the whole tune higher or lower.

C. You could make the words come up on the screen as the tune is being played by using PRINT. This could also help to make it easier to see where in the tune you have reached when you LIST the program.



FINDING OUT



Miss O. C. Termup

My advice

Always check the terms you use just as you would check the meaning of unusual words with a dictionary. Most of the terms are fairly easy to understand, but there are a lot of them. If you are unsure then check the meaning and use. The reference section is in two parts. The first gives the commands and functions and the second gives the special symbols you are likely to need. It would be very useful if you made your own reference book to contain all the terms and symbols you come across.

Olive C. Termup



Reference section

The terms which you have used in the book will all be found in the reference section, but you will also find some new terms. These are included because they may be useful when you are writing your own programs.

The reference section gives only a brief outline of the meaning and use of the terms and if you wish to find out more about them you will have to look them up in other books. The list below is given for this purpose

ZX Spectrum manual
Author: Steven Vickers
Sinclair Research

Over the Spectrum
Editor: Philip Williams
Melbourne House Publishers
ISBN 0 86759 112 9

The Spectrum Pocket Book
Author: Trevor Toms
Phipps Associates
ISBN 0950 7302 8 9

There are also a number of computer magazines which can be very helpful. Quite regularly they list programs which you might find interesting and you may well be able to adapt these programs to your own needs. Some suitable magazines are:

ZX Computing
Your Computer
Sinclair User



Commands and functions

Here is a list of all the terms that the ZX Spectrum understands. The ones in heavy type are those which are most likely to be useful to you. These are the ones described more fully in the following pages. Wait to use the other terms until you have learnt more about the computer language BASIC.

ABS
ACS
AND
ASN
AT
ATN
ATTR
BEEP
BIN
BORDER
BREAK
BRIGHT
CAPS LOCK
CAPS SHIFT
CAT
CHR\$
CIRCLE
CLEAR
CLOSE#
CLS
CODE
CONTINUE
COPY

COS
DATA
DEF FN
DELETE
DIM
DRAW
EDIT
ENTER
ERASE
EXP
FLASH
FN
FOR
FORMAT
GO SUB
GO TO
GRAPHICS
IF
IN
INK
INKEY\$
INPUT
INT
INVERSE
LEN
LET
LINE
LIST
LLIST
LN
LOAD
LPRINT
MERGE
MOVE
NEW
NEXT
NOT

OPEN#
OR
OUT
OVER
PAPER
PAUSE
PEEK
PI
PLOT
POINT
POKE
PRINT
RAND
READ
REM
RESTORE
RETURN
RND
RUN
SAVE
SCREEN\$
SGN
SIN
SPACE
SQR
STEP
STOP
STR\$
SYMBOL SHIFT
TAB
TAN
THEN
TO
USR
VAL
VAL\$
VERIFY



ABS

key **U** **[E]** mode

ABS gives the positive value of a number.

[PRINT] **[ABS]** (-7) gives 7 on the screen.

Spectrum manual page 59

ACS

key **W** **[E]** mode with symbol shift

ACS gives the angle whose cosine is known (in radians), that is arc-cosine.

Spectrum manual page 70

AND

key **Y** with symbol shift

AND is used to check whether two conditions hold.

[IF] $x > -0$ **[AND]** < 10 **[THEN]** # **[PRINT]** "digit"

See page 53

Spectrum manual page 85



ASN

key **Q** **[E]** mode with symbol shift

ASN gives the angle whose sine is known (in radians), that is arc-sine.

Spectrum manual page 70

AT

key **I** with symbol shift

AT is used with PRINT or INPUT to tell the computer where to print on the screen.

[PRINT] **[AT]** 5,9, "£" prints £ in the fifth row down and ninth column across.

See page 73

Spectrum manual page 101

ATN

key **E** **[E]** mode with symbol shift

ATN gives the angle whose tangent is known (in radians), that is arc-tan.

Spectrum manual page 70

BEEP

key **Z** **[E]** mode with symbol shift

BEEP is used to play a note.

[BEEP] 1,4 plays a note for one second which is four semitones higher than middle C.

See page 75

Spectrum manual page 135

BIN

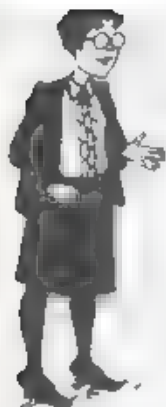
key **B** **[E]** mode

BIN tells the computer that the following number is written in binary, that is just using 0 and 1.

[PRINT] **[BIN]** 101 gives the number 5 on the screen.

See page 72

Spectrum manual page 217



BORDER

BORDER followed by a number changes the colour of the border of the screen.

[BORDER] 0 gives a black border on the screen.

See page 70

Spectrum manual page 113

BREAK

BREAK stops the computer when it is running a program.

Spectrum manual page 19

BRIGHT

[BRIGHT] 1 makes colours brighter.

See page 71

Spectrum manual page 110

CAPS LOCK

When **CAPS LOCK** has been pressed all letters are read as capitals.

See page 9

Spectrum manual page 8

CAPS SHIFT

When **CAPS SHIFT** is held down letters are printed as capitals.

See page 9

Spectrum manual page 7

CIRCLE

[CIRCLE] 50,100,30 draws a circle with centre a distance of 50 across and 100 up, and with radius 30.

See page 69

Spectrum manual page 123

CLS

[CLS] clears the screen.

key V

Spectrum manual page 103

CONTINUE

CONTINUE is used to start a program running again from where it was stopped when **BREAK** has been pressed.

Spectrum manual page 19





COS

COS gives the cosine of an angle (the angle must be given in radians).

key W **[E]** mode

Spectrum manual page 67

DATA

DATA is used with READ to supply data for a program.

key D **[E]** mode

[DATA] 1,2,3,4,5

[DATA] "apple", "banana", "carrot", "date"

See page 48

Spectrum manual page 41

DELETE

DELETE rubs out the character to the left of the cursor.

key Ø with caps shift

See page 9

Spectrum manual page 8

DIM

DIM allows groups of words or numbers to be put into the computer.

key D

[DIM] x (1Ø) allows numbers to be put into the computer with addresses x(1), x(2), x(3) ... up to x(1Ø).

Spectrum manual page 79

DRAW

DRAW draws a line on the screen.

key W

[DRAW] 3Ø,4Ø draws a straight line going to a point 3Ø across the screen and 4Ø up the screen.

See page 66

Spectrum manual page 121



EDIT

EDIT brings a line in a program to the bottom of the screen so that it can be changed.

key 1 with caps shift

See page 13

Spectrum manual page 14

ENTER

ENTER makes the computer read the line you have just typed.

See page 9

Spectrum manual page 8

EXP

EXP gives e (2.7183) to any power.

key X **[E]** mode

Spectrum manual page 65

FLASH Key V [E] mode with symbol shift

[FLASH] 1 makes characters flash.

See page 71

Spectrum manual page 110

FOR key F

FOR is used with TO and NEXT to repeat the same lines many times.

[FOR] x=0 [TO] 10: [PRINT] x: [NEXT] x

gives x the values 0,1,2 . . . 10 on the screen.

See page 47

Spectrum manual page 31



GOSUB key H

GOSUB is an instruction to go to a subroutine which starts at the line number which follows it. RETURN is used at the end of the subroutine.

See page 58

Spectrum manual page 37

GOTO key G

GOTO is an instruction to go to a particular line.

[GOTO] 410 tells the computer to go to line 410.

See page 51

Spectrum manual page 16

GRAPHICS key 9 with caps shift

When GRAPHICS has been pressed the number keys give graphics characters.

See page 9

Spectrum manual page 91

IF key U

IF is used with THEN to check if a condition holds.

[IF] a\$ = "good" [THEN] [PRINT] "I am "; a\$

See page 49

Spectrum manual page 25

INK key X [E] mode with symbol shift

INK changes the colour of characters when followed by a number between 0 and 7.

See page 70

Spectrum manual page 109

INKEY\$ key N [E] mode

INKEY\$ reads the key currently being pressed (if any).

Spectrum manual page 131



INPUT

key I

INPUT allows words or numbers to be put into the computer.

[INPUT] a (for numbers)

[INPUT] a\$ (for words)

See pages 31 and 43

Spectrum manual page 16

INT

key R [E] mode

INT gives the integer (or whole number) part of a number.

[PRINT] [INT] 45.61 gives 45 on the screen.

[PRINT] [INT] -17.22 gives -18 on the screen.

See page 55

Spectrum manual page 59

INVERSE

key M [E] mode with symbol shift

[INVERSE] 1 swaps over the paper and ink colours.

Spectrum manual page 112

LEN

key K [E] mode

LEN gives the number of characters in a word.

[PRINT] [LEN] "Termup" would print 6.

See page 56

Spectrum manual page 57

LET

key L

LET is used to give a value or word.

[LET] b=8 (for numbers)

[LET] b\$="cat" (for words)

See pages 29 and 41

Spectrum manual page 13

LIST

key K

LIST lists a program.

[LIST] lists the whole program.

[LIST] 20 lists the program from line 20 onwards.

Spectrum manual page 15

LN

key Z [E] mode

LN gives logarithms of numbers to base e (2.7183).

Spectrum manual page 67

LOAD

key J

LOAD loads a program from a cassette.

[LOAD] "water" will load the program called 'water'.

Spectrum manual page 141

MERGE key '1' [E] mode with symbol shift
MERGE loads a program from a cassette without losing any program that is already in the computer's memory (unless line numbers are repeated).

Spectrum manual page 147



NEW key A
NEW sets up the computer for a new program to be typed in (it removes any existing program).
See pages 16 and 73

Spectrum manual page 16

NEXT key N
NEXT is used with FOR and TO.
See page 47

Spectrum manual page 31

NOT key S with symbol shift
NOT a=b means that 'a does not equal b'.
See page 85

Spectrum manual page 85

OR key U with symbol shift
OR is used to check whether one of two conditions holds.
[IF] a=3 [OR] b=6 [THEN] [PRINT] "yes" will print 'yes' if either a=3 or b=6 (or both a=3 and b=6).
See page 54

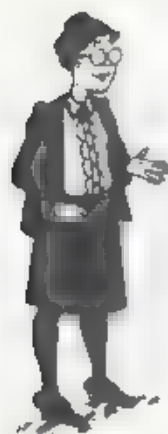
Spectrum manual page 85

OVER key N [E] mode with symbol shift
[OVER] 1 makes PRINT put characters on top of anything already there.

Spectrum manual page 113

PAPER key C [E] mode with symbol shift
PAPER followed by a number changes the background colour. See page 70

Spectrum manual page 109



PAUSE key M
[PAUSE] 50 makes the computer stop for about a second.
See page 74

Spectrum manual page 129



PI key M [E] mode
 PI=3.1415927. The circumference of a circle of radius r is
 $2 * PI * r$.

[PRINT] [PI] gives 3.1415927 on the screen.

Spectrum manual page 67

PLOT

key Q

PLOT is used to make a dot and to start to draw from a particular point.

[PLOT] 100,120 makes a dot at a distance 100 across the screen and 120 up the screen.

See page 67

Spectrum manual page 121

POKE

key O

POKE is used to store a number at a particular place in the computer's memory.

See page 72

Spectrum manual page 94

PRINT

key P

Numbers can be printed using PRINT 5.

Words can be printed using PRINT "alphabet".

[PRINT] 5,6 gives 5 6

[PRINT] 5;6 gives 56

[PRINT] 5'6 gives 5
6

See pages 22 and 39

Spectrum manual page 13

RAND

key T

RAND is short for RANDOMISE. When used on its own it makes sure that the random numbers given by RND are different each time you run the program.

Spectrum manual page 73

READ

key A [E] mode

READ is used with DATA to read information.

10 [READ] a\$,b\$,c\$,d\$

20 [DATA] "red","green","orange","blue"

30 [PRINT] b\$

prints 'green'.

See page 48

Spectrum manual page 41

REM

key E

REM is used for putting a comment or REMark into a program. The computer ignores any writing following REM.

See page 12

Spectrum manual page 16



RESTORE

key S [E] mode

RESTORE is used before READ to say which line the data should be taken from. [RESTORE] 200 means take the next data from line 200.

Spectrum manual page 42

RETURN

key Y

RETURN is used at the end of a subroutine to go back to the main part of the program.

See page 58

Spectrum manual page 37

RND

key T [E] mode

RND gives a random number between 0 and 1.

The following program chooses one of the numbers 0,1,2,3,4 at random twenty times.

```
10 [FOR] k = 1 [TO] 20  
20 [PRINT] [INT] (5* [RND] )  
30 [NEXT] k
```

See page 55

Spectrum manual page 73

RUN

key R

RUN asks the computer to run through a program.

See page 36

Spectrum manual page 14

SAVE

key S

SAVE records a program on a cassette.

[SAVE] "missile" saves a program and calls it 'missile'.

Spectrum manual page 141

SGN

key F [E] mode

SGN gives the sign of a number.

1 for positive

-1 for negative

0 for zero

Spectrum manual page 59

SIN

key Q [E] mode

SIN gives the sine of an angle (the angle must be given in radians).

Spectrum manual page 67





SPACE

SPACE is used to make a space between words.

See page 9

Spectrum manual page 8

SQR

key H **[E]** mode

SQR gives the square root of a number.

[PRINT] **[SQR]** (16) prints 4.

Spectrum manual page 60

STEP

key D with symbol shift

STEP is used with FOR and TO.

[FOR] x = 1 **[TO]** 11 **[STEP]** 2: **[PRINT]** x: **[NEXT]** x

gives x the values 1,3,5,7,9,11 on the screen.

See page 47

Spectrum manual page 32

STOP

key A with symbol shift

STOP ends the running of a program.

See pages 38 and 58

Spectrum manual page 25

SYMBOL SHIFT

SYMBOL SHIFT is used to give the symbols and words in red which are on or below the keys.

See page 9

Spectrum manual page 7

TAB

key P **[E]** mode

TAB is used to print from a particular column.

[PRINT] **[TAB]** 10; "+" will print a '+' in the tenth column.

See page 40

Spectrum manual page 103

TAN

key E **[E]** mode

TAN gives the tangent of an angle (the angle must be given in radians).

Spectrum manual page 67

THEN

key G with symbol shift

THEN is used with IF.

[IF] x = 10 **[THEN]** **[GOTO]** 600

See page 49

Spectrum manual page 25



TO
TO is used with FOR and NEXT.
See page 47

key R with symbol shift

Spectrum manual page 32

USR key L **[E]** mode
USR is used when defining user-defined graphics.
See page 72

Spectrum manual page 93

VERIFY key R **[E]** mode with symbol shift
VERIFY is used to check whether a program has been saved
on a cassette correctly.

Spectrum manual page 141



Special symbols

\$ key 4 with symbol shift
\$ is used after a letter to give a name for a word.
See page 28

Spectrum manual page 18

' key 7 with symbol shift
' is used with PRINT to give a new line.
See page 24

Spectrum manual page 17

← key 5 with caps shift
← is used to move the cursor left along a line being edited.
See page 13

↓ key 6 with caps shift
↓ is used to move the line pointer (which looks like > down a line.
See page 13

Spectrum manual page 8



↑ is used to move the line pointer (which looks like >) up a line.

See page 13

key 7 with caps shift

Spectrum manual page 8

→ is used to move the cursor right along the line being edited.

See page 13

key 8 with caps shift

Spectrum manual page 14

<= means 'is less than or equal to'. For example, $1 <= 2$, $1 <= 1$.

Spectrum manual page 25

key Q with symbol shift

<> means 'is not equal to'.

key W with symbol shift

Spectrum manual page 25

>= means 'is greater than or equal to'. For example, $4 >= 2$, $4 >= 4$.

Spectrum manual page 25

key E with symbol shift

< means 'is less than'. $1 < 2$ is true, but $2 < 2$ is not.

Spectrum manual page 25

key R with symbol shift

> means 'is greater than'. $6 > 3$ is true, but $3 > 3$ is not.

Spectrum manual page 25

key T with symbol shift

; is used with PRINT to make the printing carry on without leaving any spaces.

See page 24

key O with symbol shift

Spectrum manual page 17

" is used at the start and finish of a word or group of words that the computer is to store or print.

See page 23

key P with symbol shift



↑ key H with symbol shift
5↑2 means 5*5 and is usually written 5².

Spectrum manual page 65

— key J with symbol shift
— is the sign for subtract or take away.

+ key K with symbol shift
+ is the sign for add.

= key L with symbol shift
= means 'equals'.

: key Z with symbol shift
: is used between commands so that more than one can be written on a line.
See page 58

Spectrum manual page 17

/ key V with symbol shift
/ is the sign for divide or share.

* key B with symbol shift
* is the sign for multiply or times.



' key N with symbol shift
' is used with PRINT to space out words or numbers.
See page 24

Spectrum manual page 17

. key M with symbol shift
. is used as a decimal point.

A child's guide to the **ZX SPECTRUM**

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Here are five friendly experts, who'll help you to use your Sinclair ZX Spectrum. See how to write your own programs – draw pictures, play tunes, tell jokes, even run a game park!

P.C. Truemo
"I'll help you make sure the computer understands you – and investigate why, when it doesn't."



Pru Comet
"I'll help you understand the keyboard and learn the computer's language."



Mort Puce
"I'm an artist and I'll show you how to draw patterns, change colours and make music with your computer."



Miss O.C. Termup
"I'm in charge of the reference section of this book. I'll help you look up terms and make your own reference file."

Prof. O. Crumpet
"Ah! What a beautiful thing is a well written program! I'll show you how to plan it, write it, and run it."

